Institutional trading in volatile markets: The case of Chinese stock markets

Julia Darby[a], Hai Zhang[b], Jinkai Zhang[a]

[a] Department of Economics, School of Business, University of Strathclyde, UK

[b] Department of Accounting and Finance, School of Business, University of Strathclyde, UK

Abstract

We investigate all listed firms in Shanghai and Shenzhen stock Exchanges on extreme market movement days over 2010 to 2017, and highlight the important role of price limit on post extreme day stock returns. Utilising daily cash flow data of the largest trading group as a proxy of institutional investors trading behaviour, we identify institutional investors' consistently destabilizing effects on extreme days across two markets. We further show the upper (lower) price limit hitting stocks continue to increase (decrease) for at least two subsequent days, and find evidence of long run price reversal for lower hitting stocks. Finally we find the greater net buy by large traders the higher abnormal return in three subsequent days of the upper price limit hitting regular stocks, while the net sell on extreme days tend to predict the positive subsequent abnormal returns.

Key words: Extreme market swings; Price limit; Cash flow: Institutional trading behaviour

JEL classification: G11, G12, G14, G28

1. Introduction

The recent Chinese stock market turbulence over 2015 to 2016 has attracted attention from global investors who are seeking benefits from international risk sharing and portfolio diversification. Specific questions of interest are: Who drives to the abnormal stock returns in these extreme days? What's the pattern of stock returns on post extreme days, particularly for stocks hitting the price limit? Could the post extreme day stock return be predicted by trading activities involved in the extreme day? The

answers to those questions are important since it contributes to a better understanding of Chinese equity markets.

In order to identify the sources of extreme swings, current studies examine the trading behaviour of institutional investors by using quarterly institutional ownership data as the proxy for institutional trading on extreme movement days in U.S. stock market (Dennis and Strickland, 2002) and Chinese stock market (Tian *et al.*, 2018). Dennis and Strickland (2002) are the first to investigate on extreme days in U.S. stock market, and find firm's abnormal return on these days is associated with percentage of institutional ownership. Unlike Dennis and Strickland (2002), Tian *et al.* (2018) documents a stabilizing effect of institutional ownership on firm's abnormal returns in China's stock market. However, the quarterly horizon of institutional holding conceals important details about the undisclosed short-term activities, see in Campbell, *et al.* (2009) and Boehmer and Kelley (2009) among others.

Therefore, it is vital to explore other appropriate measure of institutional trading through which the extreme market swings could be better explained. Following Dennis and Strickland (2002), we define extreme market days as the large movement days when the absolute market return exceeds three or two standard deviation above its mean. As cash flow plays important role in explaining stock returns[1], we use a more appropriate proxy for institutional daily trading, i.e. the daily cash flow data collected from RESSET database. Similar to the Chen *et al.* (2019), we first acquire cash flow data of the largest group where the cash inflow and outflow of each transaction are above one million Chinese RMB. According to the distribution of market value held by retail investors[2], it is reasonable to assume most transactions by largest group is initiated by institutional investors. We then investigate the impact of large trading on extreme day return and find i) the large traders are net buyer (seller) on extreme up (down) days; ii) a consistent and significant evidence that the large traders, mostly comprised by institutional investors, play a destabilizing role on stock abnormal returns, however, they tends to reduce abnormal turnover on extreme down days.

Furthermore, an ignored fact in extreme market swings in Chinese stock markets is that substantial stocks hit upper (lower) price limit[3] on up (down) extreme movement days[4]. Therefore, it is worthwhile to examine post extreme day stock return, particularly for stock hitting the price limit, during extreme market swings. This paper identifies the source of extreme movement days by using daily trading data

[1] See among others, Jotikasthira *et al.*, 2012; Kirchler *et al.*, 2015; Razena *et al.*, 2017; Jiang and Yuksel, 2017; Yang and Yang, 2019.
[2] According to retail investors' holding value data from China Securities Depository & Clearing Corporation Limited, the percentage of retail accounts whose stock holding market value exceeding 1 million in 2011 and 2016 are only 0.82% and 2.75%.
[3] Chinese stock market sets daily 10% price limit for regular stocks and 5% for special treatment (ST) stocks.
[4] In 09 June 2015 when the market return of Shanghai Composite Index is 5.76%, for example, 87.7% listed tradable A-shares hit upper price limit.

in Shanghai and Shenzhen stock markets respectively from 2010 to 2017, followed by an extensive investigation on post extreme day price-limit-hitting stock returns over different horizons.

In our post extreme day study, we are particularly interested in the returns of stocks hitting price limit (i.e. ±10% limit hitting for regular stocks and ±5% limit hitting for special treatment (ST) stocks) on extreme days, given that the findings of whether price limit leads to delayed price discovery or price reversal effect in China's stock market is mixed (Chen, *et al.*, 2004; Wong *et al.* 2009 and Li, *et al.*, 2014, Chen, *et al.*, 2019). Following Chen *et al.* (2019) while setting the subsequent returns over different horizon from overnight up to 120 days, we find that i) the returns of post extreme days consistently continue to increase (decrease) at least two subsequent days for regular stocks hitting 10% (-10%) price limit. The finding contrasts with Chen *et al.* (2019) who find a significantly moderate price reversal on subsequent first day in term of open-to-close return, indicating that the price limit plays a more pronounced role of delayed price discovery after extreme days; ii) there is long run price reversal evidence for lower hitting sample in extreme down days but not upper hitting sample in up days; and iii) Similar moderate patterns can be found for ST stocks.

Using a similar set-up proposed by Chen *et al.* (2019), we also investigate whether the net buying (selling) of large trading investors on up (down) extreme days predict the stronger delayed price discovery return. Interestingly, we find significant evidence of predictive power of net buying (selling) on returns of near subsequent days in two stock markets, the power of which is more marked for regular stocks. In sum, large trading behaviour by large investors, dominated by institutions, not only exacerbates the volatile market, but also impacts on the returns on post extreme days.

This paper contributes to the literature in three aspects. First, we use the daily cash flow data by largest trading group, as dominated by institutional investors, as the proxy for institutional trading. We find large investors have a consistently destabilizing effect on extreme market swings in most cases except for extreme down days where the abnormal turnover has been reduced. Unlike Tian *et al.* (2018), our finding indicates that the quarterly institutional ownership data is less likely to capture the short-term institutional trading activity.

Second, we highlight the importance of price limit effect on extreme market swings and identify determinants of post extreme day performance particularly for price limit hitting samples. We further provide strong evidence of continuous increase (decrease) after extreme up (down) days for upper (lower) price limit hitting sample.

Third, we present evidence that the net buy (sell) by large traders has strong predictive power on post extreme day returns, reflecting institutional investors not only exacerbates the volatile markets but affects the post extreme day performances particularly for price limit hitting stocks as well.

The rest of the paper is organized as follows. In section 2, we review the extant literature and develop the hypotheses. Section 3 describes data and measures of variables. Section 4 introduces the methodology and Section 5 presents key findings. Finally Section 6 concludes. All extreme days in Shanghai and Shenzhen stock market and the analysis of ST stocks can be accessed in Appendix A and B respectively.

2. Literature review and hypotheses development

2.1 Extreme days

Cash flow has been well documented as an important factor in explaining stock returns. Kirchler *et al.* (2015) examine the impact of cash and trader inflow on price efficiency with a novel multi-period experimental asset market setting, and find the joint inflow of cash and traders triggers strong overreaction and price run-ups. In a laboratory asset market research, Razena *et al.* (2017) show that market exhibits bubbles and crashes when is associated with cash flow and long trading horizon. Jotikasthira *et al.* (2012) find the investors flows of international funds has significant price impact in emerging markets, thereby resulting in their return co-movement. They also find that the flow-performance relation of fund plays a destabilizing positive-feedback effect on the underlying markets. By using data of fund flow, Jiang and Yuksel (2017) examine the flow-performance relation for full sample of U.S. domestic equity mutual funds, and document a significantly positive relation between fund flow and subsequent fund performance. In another words, funds with net inflow outperform funds with net outflow for the subsequent one month.

In a more recent study focusing on Chinese stock market, Yang and Yang (2019) develop cash flow inflow-outflow imbalance index by using individual stock cash flow data of Chinese listed companies from 2008 to 2015 from RESSET database, and find that the inflow-outflow imbalance index is important in explaining stock excess return. However, the trading of investors by different size may have different effect on stock returns. Similar to Chen *et al.* (2019), we focus on large traders, as dominated by institutional investors in China, as they tend to be more sophisticated investors and likely to have larger impact on the stock returns on extreme days. According to the retail investors' holding value information in China, the cash flow data by largest investor acts as the compelling proxy for daily institutional trading in our study, which makes it possible to investigate the institutional investors trading behaviour on extreme days on daily frequency.

The trading behaviour of institutional and individual investors in stock market has attracted much attention in financial literature. Two well-documented trading behaviours of institutional investors are herding, which refers to following other institutional investors to buy (sell), and positive feedback trading, which refers to buying past winners and selling past losers (Lakonishok *et al.*, 1992, Nofsinger and Sias, 1999, Sias, 2004). However, the evidence of whether institutional investor stabilizes or

destabilizes the stock market in literature remains mixed. Lakonishok *et al.* (1992) show the destabilizing market effect from funds herding and positive-feedback trading behaviour, and Dennis and Stricklands (2002) demonstrate a destabilizing effect of institutional trading behaviour in large market movement days as well. While others find that the trading behaviour by institutional investors help stabilize the stock market by speeding the price-adjustment process (Wermers, 1999), reducing stock price volatility (Li and Wong, 2010) and alleviating the abnormal returns in market swings (Lipson and Puckett, 2010; Tian, *et al.* 2018).

Dennis and Strickland (2002) investigate the relationship between the stock returns and ownership structure in volatile markets when absolute value of market return is two percent or more in U.S. stock market from 1988 to 1996. They find the firm's abnormal return and abnormal turnover on these days are significantly related to its institutional ownership. Using the institutional ownership as the proxy for institutional trading, they suggest that institutional investors play a destabilizing role in the large movement days due to the positive feedback herding behaviour. A more recent research by Tian *et al.* (2018) focuses on performance of listed firms on Shanghai Stock Exchange on extreme swings on China's stock market from 2003 to 2014. Tian *et al.* (2018) also use percentage of institutional ownership as the proxy for institutional trading, and unlike Dennis and Strickland (2002), they suggest a stabilizing effect of institutional investors in China's stock market, in which, institutional investors are systematically buying more than retail investors during large market movement days, particularly on extreme market down days.

Few studies examines the institutional trading behaviour on stock performance in extreme movement days due to the less availability of institutional daily trading data (e.g. Tian *et al.*, 2018). Using a database with institutional daily trading data in U.S. stock market from 1999 to 2005, Lipson and Puckett (2010) find a stabilizing effect of institutional investors in market swings, in which institutional investors are net buyers (sellers) during extreme market declines (increases). The impact of institutional trading on stock return and turnover on extreme movement days in China's stock market remains an unexplored question. In this paper, we use the large trading as the proxy for institutional trading and test the following hypothesis.

Hypothesis 1. Large investors, mostly referred as institutional investors, tend to perform net buy (sell) trading behaviour on extreme up (down) market movement days. The daily trading by large traders exacerbates the Chinese volatile markets.

2.2 Post extreme days

2.2.1 Post extreme day performance

A notable characteristic in China's stock market is that substantial listed shares hit the price limit on large movement days. In an extreme down day of 24 August, 2015, for an example, 87.4% listed A-

shares in Shanghai Stock Exchange hit the lower price limit. Therefore it is important to analyse the delayed price discovery effect that prevent prices from efficiently reaching their equilibrium level post extreme days (Kim and Rhee, 1997).

Price limit rule has been popular in emerging market where stock market trading is dominated by retail investors, as it helps cool off the market and gives investors a time-out period on large movement days. However, the question of whether the stock will continue to rise (fall) after upper (lower) price limit hit in China's stock market is mixed in literature. Chen *et al.* (2004) investigate the effectiveness of price limit on Chinese listed A shares from 1996 to 2003 which provides evidence of price delayed effect on upward price movements but not on downward price movements. Wong *et al.* (2009) investigate the magnet effects of price limit in Shanghai Stock Exchange from Jan 2002 to Dec 2002. In post-limit-hit analysis, they find evidence of delayed price discovery at the ceiling but price reversal at the floor. Li *et al.* (2014) investigate the effectiveness, cause and impact of price limit of China's listed stocks in China (A shares), Hong Kong (H shares) and New York (N shares) over the period from stock's new listing data to May 2011.

Contrary to Chen et al. (2005) and Wong *et al.* (2009), they report the effectiveness of price limit in preventing price continuation. A more recent research by Chen *et al.* (2019) documents the destructive market behaviour of price limit, using the account-level data from Shenzhen Stock Exchange over the period from 2012 to 2015. They find the stock price continues to increase on the next day after upper limit hitting and eventually reverses over the long-run. Despite the number of price hit samples becomes larger in the extreme market days relative to normal trading days, the effectiveness of price limit on extreme market days remains unexplored question. We thus test the following hypothesis.

Hypothesis 2. The price of regular (ST) stocks continue to increase or decrease in near subsequent days after price limit hitting of ±10% (±5%) on extreme market days and eventually reverses in the long run.

2.2.2 Post extreme day return and large trading

Few studies examine the predictive power of trading behaviour on stock returns of following days. Chen *et al.* (2019) is the first in examining the predictive power of large investors on stock's subsequent returns over the different horizons from day 1 to day 120 relative to the days of price limit hitting. They find the evidence of stronger price reversal in post upper limit-hitting days when the net buying by large investors in limit-hitting days is greater, which is explained by that institutional investor is likely to conduct pump-and-dump strategy where push stocks to price limit to arouse the attention of other investors and sell it on the next day.

In order to examine whether the large trading, mostly initiated by institutional investors, in extreme days has the predictive power to post extreme day return, we then test the following hypothesis.

Hypothesis 3. The large trading on extreme day has the predictive power to post extreme day return and the power is more pronounced for the price limit-hitting regular stock on extreme day.

3. Data and measurement of variables

Our datasets include the daily market information, quarterly information of ownership concentration and institutional holding, and daily large amount trading of all listed A-shares in Shanghai and Shenzhen stock market over the period from Jan 2010 to Dec 2017. The daily market information and ownership concentration data are derived from China Stock Market & Accounting Research Database (CSMAR). Finally, the cash flow data is sourced from RESSET (www.resset.cn) database.

3.1 Extreme days

Similar to Dennis and Strickland (2002), we define extreme movement days in Shanghai (Shenzhen) stock market when absolute value of market return (i.e. Shanghai (Shenzhen) Composite Index) exceeds two standard deviations above mean. Therefore, the cut-offs of absolute value in defining extreme day in Shanghai and Shenzhen stock market are 2.90% and 3.44% respectively. As such, we have 106 (including 49 up and 57 down days) extreme days in Shanghai stock market and 116 extreme days (including 45 up and 71 down days) in Shenzhen stock market. Notably, a large amount of stock hits upper (lower) price limit in up (down) extreme days, particularly in Shenzhen stock market. We have 3 up extreme days and 4 down extreme days in Shenzhen stock market, in which the percentage of upper and lower price limit hit number accounts for more than 80%. All the information of extreme days and price limit hit is illustrated in Appendix A.

3.2 Key variables

3.2.1 Large trading data

We obtain daily cash flow data of all listed A-shares in Shanghai and Shenzhen Stock Exchanges from RESSET database, which classifies all individual buy-initiated and sell-initiated trading transaction into four categories based on the trading amount level of each transaction, which are i) less than 50 thousand RMB; ii) between 50 and 300 thousand RMB; iii) between 300 thousand and 1 million RMB and iv) bigger than 1 million RMB. Ware particularly interested in the trading behaviour in the last group, because the trading of which is mostly dominated by institutional investor. According to retail investors' holding value data from China Securities Depository & Clearing Corporation Limited, the percentage of retail accounts whose stock holding market value exceeding 1 million in 2011 and 2016 are only 0.82% and 2.75% respectively. Therefore, it is reasonable to infer that the trading in last group in mostly contributed by institutional investor. As such, similar to Chen *et al.* (2019), the key variables we define, for the proxies for daily institutional trading, are i) NETBUY, defined as the net cash inflow of the group where the amount of each transaction is above 1 million RMB and ii) NETSELL, as the negative

value of NETBUY, defined as the net cash outflow of the group where the amount of each transaction is above 1 million RMB. NETBUY and NETSELL have been scaled by the number of stock's total tradable shares.

3.3 Dependent variables

3.3.1 Extreme day

Consistent with Dennis and Strickland (2002) and Tian *et al.* (2018), we examine the performance of all listed A-shares on extreme day by abnormal return and abnormal turnover. Abnormal return is computed from the market model estimated from the time horizon from 250 to 50 prior to the extreme days (hereafter, [-250, -50]). Abnormal turnover is the difference between turnover on extreme days and the median turnover upon [-250, -50]. Turnover is represented as the trading volume on extreme day scaled by the total tradable shares outstanding.

3.3.2 Post extreme day

We also examine performance of listed A-share on post extreme day, and particularly the shares hitting price limit on extreme day is our core interest. Similar to Chen et al. (2019), we firstly examine i) CTO, which refers to the return calculated from the close price in extreme day and the open price in the following day and ii) OTC, which refers to the return calculated from the open and close price on the following day relative to extreme day. We also examine a set of abnormal returns for each share based on the different horizon, which are i) abnormal return of 1^{st} 2^{nd}, 3^{rd}, 4^{th} and 5^{th} day relative to extreme day and ii) cumulative abnormal return from [6, 10], [11, 20], [21, 60] and [61, 120] relative to extreme day.

3.4 Control variables

In accordance with the prior extreme day studies (Dennis and Strickland, 2002 and Tian, *et al.* 2018), we include a set of control variables as i) SIZE, which is the natural logarithm of the market value of equity 50 days prior to the extreme day; ii) TURNOVER, which is daily volume expressed as a percentage of shares outstanding on extreme day; iii) VARIANCE, which is market model residual variance for days [-250,-50] and iv) BETA, which is computed using returns for days [-250,-50] for the Shanghai or Shenzhen Composite index.

The inclusion of size is to ensure the relationship between abnormal return and shareholder composition or large trading is not driven by size. This is due to i) institutional investors prefer to invest in large firms (e.g. Lakonishok *et al.*, 1992); and ii) firm size is documented as the risk factor (Banz, 1981; Fama and French, 1993). Turnover ratio is included for the liquid factor as institutional investors are documented to prefer liquid stocks (Falkenstein, 1996; Gompers and Metrick, 2001). Variance is stock idiosyncratic risk and proxies for information asymmetries. Relative to retail investor, institutional

investors are document as informed investor (e.g. Wermers, 2000; Li and Wang, 2010) and the institutional holding is expected to be negatively related to information asymmetry. The inclusion of stock variance is to alleviate the concerns that institutional investors may be averse to invest in stocks with lower idiosyncratic stocks (Falkenstein, 1996). Beta is included also for another proxy for firm risk.

3.5 Descriptive statistics

Table 1 provides the descriptive statistics of key variables used in extreme days of Shanghai and Shenzhen market when the absolute market return is two standard deviation above mean. And extreme days are separated into up or down extreme days according to whether market return is positive or negative.

We observe 38740 firm-day observations in Shanghai up extreme days, which is less than 45411 firm-day observations in Shanghai down extreme days, indicating a significant asymmetry distribution of extreme days in Shanghai stock market. The distribution becomes more asymmetry toward downside in Shenzhen stock market, in which 45411 firm-day observations included in up days, which is much less than 76972 firm-day observations in down days.

The sign of NETBUY and NETSELL is one of our core interests in this study, as it reflects the trading direction of large trading investors, mostly initiated by institutional investors. And the NETBUY and NETSELL data has been multiplied by 100 for convenience. The mean or median NETBUY and NETSELL in up and down days of two market are all positive, indicating that, on average, the large trading investors tend to buy in extreme up days and sell in extreme down days in Chinese extreme stock market. The mean of NETBUY is 0.191 (0.258) in Shanghai (Shenzhen) up days, much higher than the mean of NETSELL as 0.024 (0.008) in Shanghai (Shenzhen) down days, indicating more pronounced exacerbating effect by large trading on up day relative to down day.

Regarding the discernible differences in four control variables in our study between two markets, table 1 reports the statistics of larger size of listed shared, less turnover, variance and beta in Shanghai stock market relative to Shenzhen stock market.

Table 1 Descriptive statistics

Table 1 presents the descriptive statistics of key variables used in extreme day of Shanghai and Shenzhen market when the absolute market return is two standard deviation above mean. RETURN is stock returns in extreme day. NETBUY (NETSELL) refer to net buying (selling) of the large trading, as defined earlier and has been multiplied by 100 for convenience. SIZE, TURNOVER, BETA and VARIANCE are control variables, as defined earlier.

	Mean	Min	25th	Median	75th	Max	Std.	NOB
Panel A: Shanghai up extreme days								
RETURN	0.041	-0.1	0.021	0.037	0.059	0.106	0.031	38740
NETBUY	0.191	-27.209	0	0.037	0.199	27.473	0.913	38740
NETSELL	-0.191	-27.473	-0.199	-0.037	0	27.209	0.913	38740
SIZE	22.543	19.081	21.736	22.355	23.133	28.374	1.185	38740
TURNOVER	0.032	0	0.012	0.023	0.041	0.523	0.031	38740
BETA	1.08	-0.545	0.838	1.116	1.338	2.687	0.361	38740
VARIANCE	0.072	0.002	0.034	0.057	0.095	2.059	0.062	38740
Panel B: Shanghai down extreme days								
RETURN	-0.056	-0.101	-0.093	-0.055	-0.033	0.101	0.037	45411
NETBUY	-0.024	-10.324	-0.167	-0.038	0.008	23.447	0.658	45411
NETSELL	0.024	-23.447	-0.008	0.038	0.167	10.324	0.658	45411
SIZE	22.556	19.081	21.736	22.388	23.185	28.429	1.212	45411
TURNOVER	0.032	0	0.012	0.023	0.042	0.502	0.032	45411
BETA	1.074	-0.275	0.833	1.104	1.342	3.971	0.353	45411
VARIANCE	0.083	0.002	0.042	0.067	0.105	59.354	0.286	45411
Panel C: Shenzhen up extreme days								
RETURN	0.052	-0.1	0.033	0.047	0.069	0.102	0.028	48173
NETBUY	0.258	-15.405	0	0.08	0.287	21.932	0.67	48173
NETSELL	-0.258	-21.932	-0.287	-0.08	0	15.405	0.67	48173
SIZE	22.01	18.983	21.32	21.977	22.67	26.001	1.053	48173
TURNOVER	0.041	0	0.017	0.031	0.054	0.604	0.036	48173
BETA	1.226	-1.291	1.046	1.239	1.418	2.329	0.263	48173
VARIANCE	0.117	0.003	0.043	0.073	0.112	375.562	3.295	48173
Panel D: Shenzhen down extreme days								
RETURN	-0.059	-0.101	-0.096	-0.06	-0.037	0.102	0.037	76972
NETBUY	-0.008	-13.74	-0.144	-0.012	0.024	27.578	0.655	76972
NETSELL	0.008	-27.578	-0.024	0.012	0.144	13.74	0.655	76972
SIZE	21.94	18.817	21.215	21.919	22.62	26.004	1.062	76972
TURNOVER	0.038	0	0.015	0.029	0.05	0.591	0.036	76972
BETA	1.196	-2.189	1.016	1.197	1.383	5.611	0.268	76972
VARIANCE	0.098	0.003	0.038	0.063	0.099	353.624	1.881	76972

4. Methodology

4.1 Extreme day

Our main hypothesis in extreme day study is that institutional investors exacerbate the volatile market. Given that the quarterly ownership data does not reflect well the clear pattern of institutional trading on extreme day (Campbell, *et al.* 2009; Boehmer and Kelley, 2009), we follow the set-up by Dennis and Strickland (2002) and use daily trading data to test the effect institutional trading on firm performance

on extreme days across two stock markets. We also measure the firm performance in extreme days by abnormal return and abnormal turnover.

4.1.1 Abnormal return

According to the insights provided by table 1 that large trader tend to conduct net buying trades in up extreme days and net selling trades in down extreme days, we further use NETBUY and NETSELL in up and down extreme days respectively to investigate the Hypothesis 1 that the firm performance on extreme day is associated with the large amount trading, as predominately initiated by institutional investors. We then run the following regressions in up extreme day using Fama and MacBeth (1973) approach:

$$AR_i = \gamma_0 + \gamma_1 NETBUY_i + \gamma_2 SIZE_i + \gamma_3 TURNOVER_i + \gamma_4 VARIANCE_i + \gamma_5 BETA_i + \varepsilon_i \quad (1)$$

where, AR_i is the abnormal returns of firm i in extreme days; $NETBUY_i$ is the net buy value of large amount trading scaled by number of total tradable shares outstanding for firm i. All other variables are defined as earlier.

$$ATURN_i = \gamma_0 + \gamma_1 NEYBUY_i + \gamma_2 SIZE_i + \gamma_3 VARIANCE_i + \varepsilon_i \quad (2)$$

where, $ATURN_i$ is the abnormal returns of firm i in extreme days; All other variables are defined as earlier.

We then run the regression above in down extreme days using NETSELL variable.

$$AR_i = \gamma_0 + \gamma_1 NETSELL_i + \gamma_2 SIZE_i + \gamma_3 TURNOVER_i + \gamma_4 VARIANCE_i + \gamma_5 BETA_i + \varepsilon_i \quad (3)$$

where, AR_i is the abnormal returns of firm i in extreme days; $NETSELL_i$ is the net buying of large amount trading (each sell-initiated transaction above 1 million RMB) scaled by number of total tradable shares outstanding for firm i. All other variables are defined as earlier.

$$ATURN_i = \gamma_0 + \gamma_1 NEYSELL_i + \gamma_2 SIZE_i + \gamma_3 VARIANCE_i + \varepsilon_i \quad (4)$$

where, $ATURN_i$ is the abnormal returns of firm i in extreme days; All other variables are defined as earlier.

4.2 Post extreme day

4.2.1 Performance of post extreme day

In order to test the hypothesis that whether return of price limit hitting shares continue to rise (fall) on days subsequent to extreme days (Hypothesis 2). Similar to Chen *et al.* (2019), we test the abnormal returns subsequent to hitting the upper or lower price limit and other key inner price range in extreme days. The time horizon for post extreme day returns is extended to 120 days relative to extreme days.

We decompose the first day return into i) CTO (i.e. overnight return), which refers to the return calculated from the close price in extreme day and the open price in the following day and ii) OTC, which refers to the return calculated from the open and close price on the following day relative to extreme day. We also test the cumulative abnormal return over time horizon of [6, 10], [11, 20], [21, 60] and [61, 120] relative to extreme day. Due to the different price limit level, we further separate the stocks into regular and ST stocks.

4.2.2 Post extreme day return and large trading

We proceed to investigate whether the net buy (net sell) of the largest trading investors on upper (lower) price-limit-hitting stock has predictive power for the subsequent price reversal (Hypothesis 3). Despite we would like to consistently use the technique of Fama-MacBeth (1973) where uses the time-series average of cross-sectional coefficients to make the inference, the different time horizon between net buy (net sell) on extreme day and subsequent (cumulative) abnormal return creates problem. Therefore, similar to Chen *et al.* (2019), we pool stock-day observations in our extreme up or down sample based on Shanghai or Shenzhen stock market. The samples of regular and ST stocks in regression are separated due to their different levels on price limit. We demonstrate the methodology of analysis on regular stocks as below and the methodology of ST stocks can be accessed in Appendix B.

The regression of regular stocks in extreme up days is specified as follows:

$$RET_{i,t+n\to t+m} = \gamma_0 + \gamma_1 UPPER_{i,t} + \gamma_2 NETBUY_{i,t} + \gamma_3 UPPER_{i,t} * NETBUY_{i,t} + \gamma_4 EIGHT_{i,t} + \gamma_5 EIGHT * NETBUY_{i,t} + \gamma_6 SIX_{i,t} + \gamma_7 SIX * NETBUY_{i,t} + \gamma_8 FOUR_{i,t} + \gamma_9 FOUR * NETBUY_{i,t} + \gamma_{10} SIZE_{i,t} + \gamma_{11} TURNOVER_{i,t} + \gamma_{12} VARIANCE_{i,t} + \gamma_{13} BETA_{i,t} + \varepsilon_{i,t}, n, m \in \{1,2,3,4,5,10,20,60,120\} \quad (5)$$

where, $RET_{i,t+n\to t+m}$ is the dependent variable, referring to the market-adjusted abnormal returns on day 1,2,3,4,5 and cumulative abnormal returns over days [6, 10], [11, 20], [21, 60] and [61, 120] for stock i after up extreme day t. $UPPER_{i,t}$ is dummy variable and equals to one if the stock i on event t hits the up price limit. $EIGHT_{i,t}$, $SIX_{i,t}$ and $FOUR_{i,t}$ are also dummies, referring to inner price range for stock i in extreme day t over 8% to 9.99%, 6% to 7.99% and 4% to 5.99%. All other variables are defined same as earlier.

The coefficient on the interaction term between *UPPER* and *NETBUY* is our core interest in the study. The positive coefficient of γ_3 translates Hypothesis 3, indicating the stronger price delayed effect after upper-price-limit hits with greater net buy of large trading investors in up extreme days.

The regression of regular stocks in extreme down days is specified as follows:

$$RET_{i,t+n\to t+m} = \gamma_0 + \gamma_1 LOWER_{i,t} + \gamma_2 NETSELL_{i,t} + \gamma_3 LOWER_{i,t} * NETSELL_{i,t} + \gamma_4 NEIGHT_{i,t} + \gamma_5 NEIGHT * NETSELL_{i,t} + \gamma_6 NSIX_{i,t} + \gamma_7 NSIX * NETSELL_{i,t} + \gamma_8 NFOUR_{i,t} + \gamma_9 NFOUR * NETSELL_{i,t} + \gamma_{10} SIZE_{i,t} + \gamma_{11} TURNOVER_{i,t} + \gamma_{12} VARIANCE_{i,t} + \gamma_{13} BETA_{i,t} + \varepsilon_{i,t}, n, m \epsilon \{1,2,3,4,5,10,20,60,120\}$$ (6)

where, $RET_{i,t+n\to t+m}$ is the dependent variable, referring to the market-adjusted abnormal returns on day 1,2,3,4,5 and cumulative abnormal returns over days [6, 10], [11, 20], [21, 60] and [61, 120] for stock i after up extreme day t. $LOWER_{i,t}$ is dummy variable and equals to one if the stock i on event t hits the lower price limit. $NEIGHT_{i,t}$, $NSIX_{i,t}$ and $NFOUR_{i,t}$ are also dummies, referring to inner price range for stock i in extreme day t over -9.99% to -8 %, -7.99% to -6 % and -5.99% to -4%. All other variables are defined as earlier.

The coefficient on the interaction term between *LOWER* and *NETSELL* is our core interest in the study. The positive coefficient of γ_3 translates Hypothesis 3, indicating the stronger price delayed effect after lower-price-limit hits with greater net buy of large trading investors in down extreme days.

5. Findings

5.1 Extreme day

5.1.1 Abnormal returns

Table 1 contains results in Shanghai and Shenzhen stock market respectively from separately estimating Eq. (1), (2), (3) and (4) for extreme up and down days using Fama-MacBeth (1973) technique over the years from 2010 to 2017. We focus on large amount trading, as mostly initiated by institutional investors, and its impact on stock abnormal returns and abnormal turnover in extreme market days.

To be more specific, we are particularly interested in the impact of net buy (sell) by the large investors on stock return on extreme up (down) extreme days in China's stock market. Column (1) and (3) ((2) and (4)) in table 2 present the relationship between stock abnormal return and net buy (sell) in extreme up (down) days in two stock exchanges. Our previous descriptive statistics suggest, on average, large traders perform the positive net buy and net sell trading behaviour in up and down extreme days respectively. In table 2, the coefficient of net buy of large trading investors is positively (negatively) significant at 1% in both two stock markets, suggesting a destabilizing effect of large traders on stock returns on extreme movement days. Moe specifically, the coefficient of NETBUY (NETSELL) in Shanghai stock market is 1.898 (-2.809), which corresponds to an increase (decrease) of approximately 1.9% (2.8%) in stock returns for a 1% increase of share, in total tradable shares outstanding, by net buy (sell) from large trading investors on up (down) extreme days. The destabilizing effect of large trading investors become more pronounced in Shenzhen stock market. Overall, our finding suggests that the large traders, predominated by institutional investors, play an evident destabilizing effect on China's

extreme days, which is contrary to the indication of stabilizing effect of institutional ownership (Tian *et al.*, 2018). We highlight the importance of distinguishing the impacts between quarterly institutional ownership and daily institutional trading on stock return in extreme days, because quarterly changes in ownership do not provide a clear picture of the trading patterns of institutions since quarterly horizon can mask important details about their undisclosed short-term activities (Campbell, *et al.*, 2009, Boehmer and Kelley, 2009).

Table 2 Abnormal returns and turnover on Shanghai and Shenzhen stock market

This table investigates the effects of large trading, mostly initiated by institutional investors, on stock abnormal returns and abnormal turnovers of all listed A-shares on Shanghai and Shenzhen Stock Exchange on extreme market movement days over 2010 to 2017. This table presents the results from Eq. (1), (2), (3) and (4) by using Fama-MacBeth (1973) regressions. The dependent variables are stock abnormal return (AR) on extreme day, calculated from market model over [-250, -50]; and abnormal turnover (ATURN), calculated from difference between turnover on extreme days and the median turnover upon [-250, -50]. The key variables are NETBUY and NETSELL, referring to the net buy and sell by large investors on extreme days. All other variables are same as defined earlier.

	Dependent variables: Abnormal returns				**Dependent variables: Abnormal turnovers**			
	Shanghai stock market		Shenzhen stock market		Shanghai stock market		Shenzhen stock market	
	Up day	Down day	Up day	Down day	Up day	Down day	Up day	Down day
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
NETBUY	1.898***		1.406***		1.981***		1.939***	
	(10.010)		(9.536)		(19.037)		(13.206)	
NETSELL		-2.809***		-2.529***		-1.419***		-1.137***
		(-11.848)		(-16.163)		(-10.179)		(-6.876)
SIZE	0.0001	0.003***	-0.001**	0.003***	-0.001***	-0.001**	-0.001*	-0.001
	(0.201)	(4.988)	(-2.185)	(6.180)	(-3.268)	(-2.561)	(-1.779)	(-1.046)
TURNOVER	-0.033*	0.128***	-0.046***	0.084***				
	(-1.860)	(5.723)	(-3.383)	(4.250)				
VARIANCE	0.007	-0.046***	0.012*	-0.025***	-0.047***	-0.060***	-0.065***	-0.052***
	(0.844)	(-4.995)	(1.695)	(-3.445)	(-4.654)	(-6.214)	(-6.091)	(-6.254)
BETA	-0.022***	0.023***	-0.021***	0.026***				
	(-12.285)	(8.740)	(-11.726)	(12.307)				
Constant	0.020	-0.094***	0.052***	-0.109***	0.040***	0.041***	0.032*	0.022
	(1.144)	(-6.226)	(3.972)	(-8.408)	(3.710)	(3.197)	(1.900)	(1.592)
Observations	38,740	45,411	48,173	76,972	38,740	45,411	48,173	76,972
R2	0.595	0.510	0.397	0.333	0.445	0.413	0.382	0.352

5.1.2 Abnormal turnovers

Column (5), (6), (7) and (8) in table 1 reports the impact of NETBUY and NETSELL on stock abnormal turnover on extreme days, the independent variables of which is our core interest. Surprisingly, the empirical evidence reports that the net buy by large trading investors (NETBUY) exacerbates the

abnormal return on up extreme days whereas the net sell (NETSELL) decreases the abnormal return on down extreme days. More specifically, one percentage increase of NETBUY by large investors corresponds to, on average, an increase of approximately 1.981 (1.939) percentage on abnormal turnover in Shanghai (Shenzhen) extreme up days. However, in Shanghai (Shenzhen) extreme down days, one percentage increase of NETSELL tend to decrease the abnormal turnover by approximately 1.419 (1.137) percentage. To sum up, the trading behaviour of large traders have different impact on the abnormal turnover between up and down extreme days. A potential explanation is that the more panic selling on down extreme days induced by large trading investors lead to more samples of price limit hitting, which decreases the liquidity of stocks (e.g. Kim and Rhee, 1997).

5.2 Post extreme day

5.2.1 Abnormal returns in post extreme days

Table 3 and Table 4 report the price pattern of post extreme day performance for stocks hitting upper (lower) price limit on extreme up (down) days in Shanghai Stock Exchange (SHSE) Shenzhen Stock Exchange (SZSE) respectively over 2010 to 2017. Similar to Chen *et al.* (2019), we also compare the price limit hitting samples with stocks, the closing returns of which falls into different key ranges (e.g. 9% to 10%, 8% to 9%). We further separate i) regular stocks and ST stocks in each table due to their different limit of price hitting; and ii) up and down extreme days in each tables. Consistently, the abnormal return is calculated from market model over days [-250, -50] relative to each extreme day.

Regular stocks

With respect to the first subsequent day performance for regular stocks in Shanghai up extreme days, the first row of Panel A in Table 3 reports the close-to-open (CTO) return on average is 2.64% (significant at 1% level), and continue to increase during the first day's trading hours by average 1.52% (significant at 1% level), which contrasts with the finding by Chen *et al.* (2019) that a small amount of price reversal is found in first day's close price relative to open price in all days' investigation over 2012 to 2015. Our result indicates a more pronounced continuous price increase in the first subsequent day relative extreme days for up price limit hitting stocks. Further, the price continues to rise on average 1.78% (significant at 1% level) in the second subsequent day for upper price limit hitting stocks on extreme up days, and a significant pattern of price reverse is found in day 3 and day 4. However, there is no consistent evidence of price reverse in the long run. When in comparison with the post extreme day performance of large returns (without up limit hitting) on extreme up days, in general, a significant price reverse is found in the three subsequent days relative to extreme days, which differs evidently with the price limit hitting samples, indicating the important role of price limit plays on the post extreme day performance.

In the extreme down markets in Shanghai stock market, the last row in Panel B shows the price pattern following lower-limit hits. The close-to-open price (CTO) of -2.49% (significant at 1% level) indicates the significant drop of stock price by 2.49% on average at the open price of first day, and continued with moderate drop of open-to-close (OTC). Afterward, the stocks keep a downward tendency for several subsequent days and have a price reversal in the long run. For example, the cumulated abnormal returns of [61, 120] for lower price limit hitting sample on down extreme day is 1.86% (significant at 1% level). In comparison to price limit samples, the stock prices of other large inner range drop more moderate than lower price limit hitting samples in near subsequent days, reflecting the important continuous price decreasing effect of lower price limit.

Overall, the continue increase (decrease) of price pattern in subsequent days is observed in up (down) days for upper (lower) price limit hitting samples in SHSE. Further, a long-run price reversal is observed in lower price limit samples, but not in upper price limit samples. The price pattern of stocks in SZSE is consistent with SHSE.

ST stocks

The findings of ST stocks can be accessed in Appendix B. Panel A (Panel B) in Table B-1 and Table B-2 demonstrate the price pattern for ST stocks. The upper limit hitting ST stocks exhibit continue price increase pattern in SZSE but not in SHSE. Further, there is no long run price reversal detected for upper hitting ST stock in both two markets.

With respect to the price pattern of ST stocks in extreme down days, however, a significant continuous price decrease is found in both two markets. In other words, the lower hitting ST stocks drops significantly at CTO, followed by a moderate small price reversal at OTC, and keeps significant downward price drop for at least four subsequent days. A small long run price reverse of 0.99% (significant at 1% level) is found for ST stocks in SZSE but not SHSE.

Overall, the price pattern of post extreme days for ST stocks largely depend on the up or down of extreme days. The lower price limit hitting of ST stocks continue to drop on the subsequent days, and the upper price limit hitting ST stocks do not exhibit such pattern. Further, generally there is no significant price reverse pattern in long run for ST limit hitting samples.

Table 3 Post extreme day performance of regular stocks in Shanghai stock market

Table 3 presents the stock abnormal returns subsequent to extreme days in Shanghai stock market. The sample includes all stocks listed in Shanghai stock market from 2010 to 2017. CTO refers to the return calculated from the close price in extreme day and the open price in the following day. OTC refers to the return calculated from the open and close price on the following day. Day 2, 3, 4 and 5 refer to the abnormal return on the 2nd, 3rd, 4th and 5th relative to extreme day. [6, 10], [11, 20], [21, 60] and [61, 120] refer to the cumulative abnormal return from time window over 6th to 10th, 11th, to 20th, 21st to 60th, and 61st to 120th day relative to extreme day. The abnormal return is calculated as using stock's daily return minus the expected return derived from market model. The table reports log returns. "***", "**" and "*" represent the significance level at 0.1%, 1% and 5% respectively.

	CTO	OTC	Day 2	Day 3	Day 4	Day 5	[6, 10]	[11, 20]	[21, 60]	[61, 120]	No.
Panel A Regular stocks in Shanghai up extreme days											
Upper Hit	2.64%***	1.52%***	1.31%***	-0.78%***	-0.41%***	1.06%***	2.06%***	-2.94%***	1.69%***	0.06%	3300
[9%, 10%)	-0.06%	-0.16%	-0.45%**	-0.24%	0.51%***	0.54%***	0.49%	-5%***	1.09%*	0.52%	1050
[8%, 9%)	-0.59%***	-0.38%**	-1.08%***	-0.39%**	0.73%***	-0.02%	0.31%	-3.14%***	1.83%***	-0.99%**	1139
[7%, 8%)	-0.27%***	0.3%**	-0.53%***	-0.36%***	0.38%***	-0.04%	0.17%	-2.61%***	1.03%**	-0.66%*	1542
[6%, 7%)	-0.25%***	0.49%***	-0.47%***	-0.06%	0.02%	-0.18%*	0.55%*	-1.42%***	1.22%***	0.05%	2310
[5%, 6%)	-0.21%***	0.8%***	-0.3%***	0.17%**	-0.01%	0.07%	1.23%***	-0.86%***	1.02%***	0.87%***	3249
[-5%, 5%)	-0.16%***	0.55%***	0.03%	0.05%**	-0.42%***	0.08%***	1.22%***	0.29%***	1.76%***	0.95%***	24770
(-10%, -5%)	-1.35%***	0.8%	-2.21%***	-2.22%***	-3.2%***	-0.12%	-4.03%	-3.38%	2.74%	-1.96%	64
Lower Hit	-7.54%***	5.43%**	-5.52%***	-4.28%**	-5.01%**	-1.33%	-8.78%	-5.69%	3.27%	3.68%	18
Panel B Regular stocks in Shanghai down extreme days											
Upper Hit	0.09%	1.53%**	-0.22%	-0.65%	-1.11%**	-0.82%*	2.02%	-1.55%	-1.76%	3.5%**	180
[5%, 10%)	-2.18%***	2.01%***	0.01%	-1.19%***	-0.87%**	-1.33%***	0.18%	-0.56%	0.41%	1.1%	280
[-5%, 5%)	-0.51%***	0.67%***	-0.17%***	-0.17%***	-0.5%***	-0.3%***	0.76%***	0.37%***	0.72%***	1.19%***	18362
[-6%, -5%)	-0.46%***	0.23%***	0%	-0.15%**	-0.42%***	-0.09%*	0.59%**	0.76%***	0.85%***	1.11%***	4139
[-7%, -6%)	-0.56%***	0.25%***	-0.09%	-0.21%***	-0.45%***	-0.08%	0.65%**	0.31%	0.38%*	1.06%***	3389
[-8%, -7%)	-0.66%***	0.42%***	-0.05%	-0.47%***	-0.42%***	0.09%	0.86%**	0.66%*	0.8%***	0.81%***	2768
[-9%, -8%)	-0.45%***	0.3%**	-0.07%	-0.7%***	-0.51%***	0.34%***	0.71%*	0.8%**	0.65%**	0.91%***	2368
(-10%, -9%)	-0.66%***	0.63%***	-0.02%	-0.42%***	-0.39%***	0.04%	0.76%**	0.61%*	0.11%	1.28%***	3528
Lower Hit	-2.49%***	-0.24%**	-0.86%***	-0.94%***	-0.81%***	-1.25%***	-3.56%***	2.93%***	-0.13%	1.86%***	8678

Table 4 Post extreme day performance of regular stocks in Shenzhen stock market

Table 4 presents the stock abnormal returns subsequent to extreme days in Shenzhen stock market. The sample includes all stocks listed in Shenzhen stock market from 2010 to 2017. CTO refers to the return calculated from the close price in extreme day and the open price in the following day. OTC refers to the return calculated from the open and close price on the following day. Day 2, 3, 4 and 5 refer to the abnormal return on the 2nd, 3rd, 4th and 5th relative to extreme day. [6, 10], [11, 20], [21, 60] and [61, 120] refer to the cumulative abnormal return from time window over 6th to 10th, 11th, to 20th, 21st to 60th, and 61st to 120th day relative to extreme day. The abnormal return is calculated as using stock's daily return minus the expected return derived from market model. The table reports log returns. "***", "**" and "*" represent the significance level at 0.1%, 1% and 5% respectively.

	CTO	OTC	Day 2	Day 3	Day 4	Day 5	[6, 10]	[11, 20]	[21, 60]	[61, 120]	No.
Panel A Regular stocks in Shenzhen up extreme days											
Upper Hit	2.59%***	0.8%***	0.46%***	-0.15%**	-0.09%	0.44%***	1.46%***	0.36%	1.41%***	1.63%***	5925
[9%, 10%)	-0.15%	-0.4%***	-0.41%***	-0.38%***	0.43%***	0.01%	1.56%***	0.51%	1.19%**	1.12%**	1460
[8%, 9%)	-0.51%***	0.02%	-0.27%***	-0.25%**	0.46%***	0%	1.91%***	0.67%	1.53%***	0.84%**	1848
[7%, 8%)	-0.57%***	0.3%***	-0.24%***	0.09%	0.35%***	0.04%	2.68%***	0.96%***	1.87%***	0.48%*	2612
[6%, 7%)	-0.24%***	0.6%***	-0.1%*	-0.03%	0.16%***	-0.01%	2.15%***	0.92%***	1.28%***	1.11%***	3868
[5%, 6%)	-0.11%***	0.74%***	-0.07%	-0.01%	0.16%***	0.15%***	1.98%***	0.96%***	1.39%***	1.27%***	5772
[-5%, 5%)	-0.14%***	0.81%***	-0.09%***	-0.11%***	-0.07%***	-0.03%*	1.46%***	1.12%***	1.43%***	1.46%***	25993
(-10%,-5%)	-2.06%***	-1.11%	-2.13%***	-1.93%**	-3.01%***	-0.37%	-3.19%	-0.17%	3.2%	0.18%	44
Lower Hit	-9%***	1.67%*	-5.42%***	-3.54%***	-1.04%	-1%	2.58%	-0.68%	1.6%	2.92%*	56
Panel B Regular stocks in Shenzhen down extreme days											
Upper Hit	-0.14%	3.25%***	0.89%**	0.33%	0.3%	-0.79%***	1.05%	2.79%**	1.48%*	2.31%***	393
[5%, 10%)	-1.98%***	2.65%***	-0.71%***	-0.67%***	-0.53%**	-0.74%***	-0.54%	0.06%	2.06%**	1.52%**	485
[-5%, 5%)	-0.79%***	1.14%***	0.02%	-0.12%***	-0.2%***	-0.08%***	0.9%***	0.96%***	1.02%***	1.11%***	28513
[-6%,-5%)	-0.57%***	0.72%***	0.13%***	0.08%**	0.02%	0.02%	1.21%***	1.06%***	1.16%***	1.09%***	7857
[-7%,-6%)	-0.67%***	0.65%***	0.11%***	0.03%	0.02%	0.11%***	1.5%***	1.3%***	1.26%***	1.27%***	6848
[-8%,-7%)	-0.72%***	0.76%***	0.15%***	0%	0.04%	0.11%**	1.76%***	1.3%***	1.25%***	1.32%***	5401
[-9%,-8%)	-0.92%***	0.87%***	0.21%***	-0.01%	0.12%**	0.13%**	2.18%***	1.24%***	1.01%***	1.27%***	4403
(-10%,-9%)	-0.86%***	0.85%***	0.32%***	0.23%***	0.13%**	0.2%***	2.29%***	1.43%***	1.45%***	1.69%***	5238
Lower Hit	-2.92%***	-0.49%***	-0.19%***	0.02%	0.16%***	0.12%***	2.28%***	2.9%***	1.36%***	2.09%***	16653

5.2.2 Post extreme day return and large trading

Regular stocks

Panel A and Panel B in Table 5 (Table 6) report the regression analysis of Eq. (5) and (6) for regular stocks in Shanghai (Shenzhen) extreme up and down days respectively.

For regular stocks in up extreme days (Panel A in Table 5 and Table 6), the coefficients of our key interest, as of the interaction term UPPER*NETBUY, are consistently positive over the three subsequent days relative to extreme days in two stock market, which is consistent with Hypothesis 3 that stronger price continuous increase after upper price limit hits with larger net buy of large traders, mostly as initiated by institutional investors. Specifically, the coefficient of UPPER*NETBUY in first subsequent day relative to Shanghai (Shenzhen) extreme up day is 0.468 (1.413), corresponding to that, on average, the increase of one percentage of net buy by large traders on Shanghai (Shenzhen) extreme up day will lead to approximately an increase of 0.468% (1.413%) abnormal return on the first subsequent day for upper price limit hitting stock.

Our finding contrast with Chen *et al.* (2019) where the negative coefficient of interaction term is found for full samples over 2012 to 2015, reflecting the fact that the net buy by large traders not only exacerbate the abnormal return in extreme days, but also contribute to higher returns in near subsequent days for stocks hitting upper price limit. Such patterns are not found in the stock with large inner stock return in extreme days, which further highlight the distinctive price movement patterns for price limit hitting stock. Furthermore, the coefficient of NETBUY also translates the predictive power on stock returns on subsequent days. The coefficients of NETBUY in SZSE are significantly negative over the four following days, though the significance is only found in the second following day in SHZE. The finding indicates the predictive power of NETBUY on price reversal of near subsequent days, particularly in Shenzhen stock market.

For regular stocks in down extreme days (Panel B in Table 5 and Table 6), the coefficients of interaction term LOWER*NETSELL are significantly positive in subsequent three days relative to extreme days in SZSE, indicating the stronger price reversal in near following days for stocks hitting lower price limit on extreme days, with the increase of NETSELL. In Shanghai stock market, however, the similar patterns are not identified. Nonetheless, the coefficient of NETSELL in SHSE in the first following day is 0.167 and significant at 1% level, translating an average increase of 0.167% abnormal stock return in first subsequent day with the increase of one percentage of net buy by large traders. All these positive coefficients associated with NETSELL in two stock exchanges indicate that the net sell on extreme down days, largely due to panic selling, predict the positive returns on the near subsequent days.

ST stocks

In Appendix B., Panel A and Panel B in Table B-3 (Table -4) reports the regression analysis of Eq. (B-1) and (B-2) for ST stocks in Shanghai (Shenzhen) extreme up and down days respectively. On Shanghai up extreme days, we also find the significantly positive coefficients of NETBUY in subsequent two days relative to extreme days, which is supportive to the predictive power of NETBUY on returns for ST stocks hitting 5% price limit. More specifically, one percentage increase of NETBUY will lead to an average increase of return with 0.607% on first day following Shanghai up extreme days. The coefficients of interaction term, however, are mostly insignificant.

On down extreme days, the positive coefficient of interaction term LFIVE*NETSELL on first subsequent day in Shanghai stock market suggests that the price reversal is stronger for ST stocks hitting the down price limit with the increase of NETSELL on Shanghai extreme day. However, the similar pattern does not exist on Shenzhen stock market. In sum, the predictive power of net buy or net sell in extreme days on subsequent days is more moderate for ST stocks compared to regular stocks.

Table 5 Regression analysis of regular stocks in Shanghai Stock Exchange

This table reports the regression evidence of regular stocks estimated from Eq. (5) and (6) in extreme days in Shanghai stock market over 2010 to 2017, while samples are further separated according to from up or down extreme day. Panel A reports the findings in extreme up days, in which the key variable UPPER refers to regular stocks hitting 10% price limit and NETBUY refers to net buy of large trading investors. Panel B reports the regressions for regular stocks in extreme up days, in which the key variable LOWER refers to regular stocks hitting -10% price limit and NETSELL refers to net sell of large trading investors. All other variables are same as defined earlier. Standard errors are adjusted for heteroscedasticity and t-statistics are reported in parentheses.

Panel A Regular stocks from Shanghai up extreme days

	AR Day1	AR Day2	AR Day3	AR Day4	AR Day5	CAR [6,10]	CAR [11,20]	CAR [21,60]	CAR [61,120]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
UPPER	0.035***	0.011***	-0.008***	0.004***	0.01***	0.005	-0.031***	-0.006*	-0.008***
	(25.644)	(9.959)	(-7.368)	(3.432)	(10.979)	(1.302)	(-7.825)	(-1.848)	(-2.6)
NETBUY	0.056	-0.14***	0.017	0.088**	-0.03	0.145	-0.482***	-0.292*	-0.07
	(1.082)	(-3.271)	(0.473)	(2.109)	(-0.836)	(0.94)	(-2.631)	(-1.687)	(-0.598)
UPPER* NETBUY	0.468***	0.497***	0.192**	-0.397***	-0.111*	0.008	1.252***	0.762***	0.256
	(4.61)	(6.163)	(2.461)	(-4.994)	(-1.701)	(0.035)	(4.258)	(3.393)	(1.266)
[8%, 10%)	-0.01***	-0.009***	-0.003***	0.012***	0.001	-0.007*	-0.041***	-0.008**	-0.014***
	(-8.047)	(-8.381)	(-2.746)	(11.542)	(0.86)	(-1.723)	(-9.5)	(-2.221)	(-4.518)
[8%, 10%)* NETBUY	0.661***	0.669***	0.11	-0.423***	-0.028	-0.842	1.389**	1.483***	0.893**
	(3.83)	(4.801)	(0.924)	(-3.137)	(-0.248)	(-1.353)	(2.427)	(3.158)	(1.975)
[6%, 8%)	0	-0.004***	-0.001*	0.007***	-0.002***	-0.009***	-0.02***	-0.006***	-0.012***
	(-0.012)	(-5.97)	(-1.72)	(9.375)	(-3.357)	(-3.38)	(-7.263)	(-2.82)	(-5.641)
[6%, 8%)* NETBUY	-0.035	0.408***	-0.027	-0.304***	-0.206**	-0.005	1.229***	0.176	0.694**
	(-0.315)	(3.187)	(-0.194)	(-3.501)	(-2.488)	(-0.012)	(4.226)	(0.505)	(2.546)
[4%, 6%)	0.006***	-0.001***	0.001	0.003***	-0.001**	0.001	-0.008***	-0.008***	-0.002
	(10.485)	(-2.772)	(1.378)	(6.005)	(-2.547)	(0.538)	(-4.586)	(-5.294)	(-1.431)
[4%, 6%)* NETBUY	-0.494***	0.555***	0.315***	0.188*	-0.026	0.779**	0.879**	0.549	-0.08

	(-4.348)	(5.716)	(2.889)	(1.897)	(-0.231)	(2.018)	(1.965)	(1.523)	(-0.251)
SIZE	-0.001***	-0.001***	-0.001***	0.001***	0***	0.001**	0.001	-0.003***	-0.001**
	(-9.082)	(-5.559)	(-6.387)	(7.007)	(-3.383)	(2.186)	(1.022)	(-6.046)	(-2.461)
TURNOVER	-0.127***	-0.103***	-0.077***	-0.036***	-0.009	-0.043	-0.206***	-0.065**	-0.099***
	(-12.907)	(-10.776)	(-9.03)	(-4.424)	(-1.112)	(-1.38)	(-6.817)	(-2.201)	(-3.708)
VARIANCE	0.009***	-0.016***	0.014***	0.017***	0.019***	0.054***	-0.042***	0.002	-0.006
	(2.929)	(-4.279)	(3.676)	(5.542)	(5.526)	(4.116)	(-2.615)	(0.216)	(-0.663)
BETA	-0.004***	-0.01***	0.006***	-0.005***	-0.003***	-0.013***	0.028***	0.002	0.006***
	(-5.99)	(-19.05)	(11.11)	(-10.089)	(-6.443)	(-5.508)	(11.723)	(0.78)	(3.187)
constant	0.04***	0.031***	0.014***	-0.017***	0.012***	-0.002	-0.032**	0.079***	0.034***
	(11.536)	(9.743)	(4.609)	(-6.434)	(4.407)	(-0.178)	(-2.369)	(7.504)	(2.884)
Number	37409	37408	37408	37408	37408	37405	37394	37349	37240
R.2	0.082	0.04	0.014	0.015	0.011	0.003	0.021	0.002	0.003
Adjust.R.2	0.082	0.039	0.013	0.015	0.011	0.003	0.02	0.002	0.002
Panel B Regular stocks from Shanghai down extreme days									
LOWER	-0.027***	-0.006***	-0.005***	0	-0.007***	-0.04***	0.034***	-0.008***	0.006***
	(-34.3)	(-9.085)	(-8.428)	(0.235)	(-11.313)	(-14.922)	(14.534)	(-4.323)	(4.042)
NETSELL	0.167**	0.033	0.071	-0.025	-0.08	-0.154	-0.197	0.108	-0.01
	(2.543)	(0.622)	(1.333)	(-0.518)	(-1.61)	(-0.76)	(-1.049)	(0.747)	(-0.108)
LOWER* NETSELL	-0.273	-0.128	-0.837***	-0.733***	0.127	-2.45***	-1.926***	0.626	0.024
	(-1.583)	(-1.132)	(-6.377)	(-5.632)	(1.061)	(-5.541)	(-5.316)	(1.521)	(0.1)
(-10%,-8%]	-0.005***	0.002***	-0.003***	0.002***	0.005***	0.002	0.006**	-0.003	0
	(-6.286)	(3.273)	(-5.074)	(3.006)	(7.409)	(0.805)	(2.36)	(-1.6)	(0.081)
(-10%,-8%]* NETSELL	-0.214	-0.433***	-0.664***	-0.672***	0.138	-1.864***	-0.541	-0.537	-0.373
	(-0.985)	(-3.183)	(-4.21)	(-4.498)	(0.885)	(-3.296)	(-1.068)	(-1.167)	(-1.012)
(-8%,-6%]	-0.006***	0.001***	-0.002***	0.001***	0.003***	0.001	0	-0.003*	-0.003*
	(-7.962)	(2.886)	(-2.872)	(2.634)	(6.463)	(0.507)	(0.043)	(-1.685)	(-1.647)
(-8%,-6%]* NETSELL	-0.568***	-0.257*	-0.166	-0.31**	-0.093	-0.728	1.09*	1.034*	0.097
	(-2.772)	(-1.716)	(-1.041)	(-2.177)	(-0.589)	(-1.323)	(1.923)	(1.841)	(0.227)
(-6%,-4%]	-0.004***	0.002***	0	0.002***	0.002***	0.001	0.004**	-0.001	0
	(-7.285)	(5.282)	(0.397)	(3.901)	(4.007)	(0.716)	(1.974)	(-0.53)	(-0.368)
(-6%,-4%]* NETSELL	-0.588**	-0.387**	-0.017	-0.205	-0.062	-0.096	-0.206	0.535	-0.05
	(-2.329)	(-2.51)	(-0.115)	(-1.336)	(-0.444)	(-0.223)	(-0.387)	(1.465)	(-0.2)
SIZE	0	0.001***	0.001***	0.001***	0	0.001	-0.004***	-0.001***	-0.002***
	(-0.557)	(5.633)	(4.624)	(7)	(1.509)	(1.617)	(-8.155)	(-3.139)	(-6.866)
TURNOVER	0.028**	0.009	-0.046***	-0.048***	-0.053***	0.082**	-0.178***	-0.07***	-0.017
	(2.555)	(1.216)	(-5.878)	(-6.652)	(-7.061)	(2.557)	(-6.175)	(-2.935)	(-0.798)
VARIANCE	0*	0	0.001	0	0.001*	0.003***	0	0	0
	(1.866)	(-0.138)	(1.189)	(-0.25)	(1.768)	(4.573)	(0.027)	(-0.008)	(0.554)
BETA	0.027***	0.006***	0.009***	0.01***	0.013***	0.013***	0.028***	0.001	-0.001
	(33.376)	(11.613)	(20.521)	(20.786)	(22.335)	(5.138)	(13.006)	(0.415)	(-0.821)
constant	-0.025***	-0.026***	-0.024***	-0.04***	-0.022***	-0.029**	0.067***	0.036***	0.068***
	(-5.301)	(-8.25)	(-8.126)	(-11.362)	(-5.783)	(-2.335)	(5.903)	(3.852)	(7.995)
Number	43629	43628	43627	43626	43625	43620	43604	43535	43395
R.2	0.068	0.012	0.022	0.021	0.034	0.015	0.012	0.002	0.002
Adjust.R.2	0.068	0.012	0.022	0.021	0.034	0.014	0.012	0.002	0.001

Table 6 Regression analysis in Shenzhen stock Exchange

This table reports the regression evidence of regular stocks estimated from Eq. (5) and (6) in extreme days in Shenzhen stock market over 2010 to 2017, while samples are further separated according to from up or down extreme day. Panel A reports the findings in extreme up days, in which the key variable UPPER refers to regular stocks hitting 10% price limit and NETBUY refers to net buy of large trading investors. Panel B reports the regressions for regular stocks in extreme up days, in which the key variable LOWER refers to regular stocks hitting -10% price limit and NETSELL refers to net sell of large trading investors. All other variables are same as defined earlier. Standard errors are adjusted for heteroscedasticity and t-statistics are reported in parentheses.

Panel A Regular stocks from Shenzhen up extreme days									
	AR Day1	AR Day2	AR Day3	AR Day4	AR Day5	CAR [6,10]	CAR [11,20]	CAR [21,60]	CAR [61,120]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
UPPER	0.026***	0.008***	0	0.001**	0.006***	0.005*	-0.001	0	0.002
	(22.198)	(10.735)	(-0.612)	(1.958)	(8.611)	(1.802)	(-0.448)	(-0.102)	(0.765)
NETBUY	-0.969***	-0.167**	-0.342***	-0.413***	-0.054	1.325***	-0.388*	0.154	0.122
	(-6.835)	(-2.425)	(-4.614)	(-5.825)	(-0.823)	(3.267)	(-1.851)	(0.681)	(0.479)
UPPER* NETBUY	1.413***	0.182**	0.451***	0.308***	-0.038	-1.56***	-0.129	-0.02	-0.254
	(8.547)	(2.149)	(5.192)	(3.662)	(-0.496)	(-3.53)	(-0.454)	(-0.073)	(-0.873)
[8%, 10%)	-0.011***	-0.001	0	0.007***	0.001	0.007**	-0.005	-0.001	-0.007***
	(-8.395)	(-1.073)	(-0.62)	(10.531)	(1.255)	(2.185)	(-1.604)	(-0.282)	(-2.903)
[8%, 10%)* NETBUY	1.524***	0.21	0.195	-0.043	-0.107	-1.772***	0.425	0.121	0.249
	(5.092)	(1.635)	(1.317)	(-0.377)	(-0.981)	(-3.457)	(1.295)	(0.356)	(0.66)
[6%, 8%)	-0.005***	0.001**	0.002***	0.004***	0	0.011***	0	0.004**	-0.008***
	(-5.068)	(1.974)	(3.499)	(9.239)	(0.489)	(4.895)	(0.059)	(2.11)	(-3.846)
[6%, 8%)* NETBUY	1.39***	0.101	0.469***	0.064	0.057	-1.478***	-0.168	-1.293***	0.172
	(5.323)	(0.949)	(4.226)	(0.586)	(0.584)	(-2.562)	(-0.453)	(-2.858)	(0.422)
[4%, 6%)	0.001*	0.001***	0.002***	0.002***	0.001**	0.004**	0	-0.001	-0.003**
	(1.797)	(2.56)	(6.325)	(5.63)	(2.082)	(2.351)	(-0.082)	(-0.646)	(-2.14)
[4%, 6%)* NETBUY	1.33***	0.214	0.174*	0.206	0.219*	-0.131	-0.288	0.396	1.239
	(6.197)	(1.496)	(1.666)	(1.476)	(1.837)	(-0.212)	(-0.651)	(1.043)	(1.423)
SIZE	-0.002***	-0.001***	-0.001***	0	-0.001***	-0.003***	0	-0.001**	-0.001***
	(-12.878)	(-11.739)	(-4.616)	(-1.244)	(-6.487)	(-5.157)	(-0.21)	(-2.029)	(-2.868)
TURNOVER	-0.121***	-0.097***	-0.027***	0.002	-0.009*	-0.082***	-0.058**	-0.08***	0.032*
	(-12.683)	(-16.717)	(-4.667)	(0.367)	(-1.734)	(-3.423)	(-2.287)	(-3.952)	(1.662)
VARIANCE	0***	0**	0***	0***	0***	0	0	0***	0***
	(2.841)	(2.031)	(17.355)	(9.405)	(7.212)	(1.458)	(0.967)	(14.67)	(-7.824)
BETA	-0.001	0.003***	0.001*	-0.004***	0.006***	0.018***	-0.001	0.009***	0.001
	(-1.245)	(6.462)	(1.819)	(-6.538)	(10.938)	(6.502)	(-0.262)	(3.673)	(0.635)
constant	0.066***	0.029***	0.01***	0.007**	0.009***	0.06***	0.017	0.029**	0.044***
	(15.592)	(10.523)	(3.764)	(2.455)	(3.501)	(4.452)	(1.362)	(2.484)	(3.805)
Number	47534	47533	47533	47532	47530	47523	47508	47363	47000
R.2	0.047	0.017	0.004	0.007	0.007	0.004	0.001	0.001	0.002
Adjust.R.2	0.047	0.017	0.004	0.007	0.006	0.003	0.001	0.001	0.001
Panel B Regular stocks from Shenzhen down extreme days									
	AR Day1	AR Day2	AR Day3	AR Day4	AR Day5	CAR [6,10]	CAR [11,20]	CAR [21,60]	CAR [61,120]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LOWER	-0.043***	-0.001***	0.002***	0.004***	0.002***	0.014***	0.02***	0.003***	0.01***
	(-64.917)	(-2.93)	(4.971)	(13.263)	(6.512)	(7.846)	(13.543)	(2.608)	(7.618)
NETSELL	0.033	0.056*	-0.014	-0.027	0.091***	-0.043	-0.048	-0.172*	-0.214
	(0.614)	(1.785)	(-0.381)	(-0.876)	(2.916)	(-0.371)	(-0.507)	(-1.733)	(-1.417)
LOWER* NETSELL	1.124***	0.189***	0.158**	-0.168**	-0.06	-0.012	0.02	0.388*	-0.017

	(9.375)	(2.874)	(2.042)	(-2.404)	(-0.867)	(-0.041)	(0.07)	(1.692)	(-0.079)
(-10%,-8%]	-0.009***	0.004***	0.003***	0.004***	0.003***	0.014***	0.005***	0.003*	0.004***
	(-12.306)	(9.844)	(7.695)	(10.225)	(7.002)	(8.245)	(3.496)	(1.74)	(2.807)
(-10%,-8%]* NETSELL	0.347**	-0.249**	0.027	0.081	0.002	-0.336	-0.345	0.162	0.006
	(1.978)	(-2.337)	(0.274)	(0.939)	(0.025)	(-0.98)	(-1.054)	(0.522)	(0.02)
(-8%,-6%]	-0.007***	0.002***	0.002***	0.003***	0.002***	0.009***	0.004***	0.002*	0.001
	(-10.673)	(5.549)	(5.338)	(8.29)	(7.014)	(6.288)	(2.782)	(1.66)	(0.865)
(-8%,-6%]* NETSELL	-0.194	0.078	0.033	0.032	-0.109	-0.886***	0.035	0.617**	0.34
	(-1.054)	(0.913)	(0.328)	(0.458)	(-1.357)	(-2.872)	(0.107)	(2.046)	(0.941)
(-6%,-4%]	-0.005***	0.002***	0.002***	0.002***	0.001***	0.004***	0.002	0.001	-0.001
	(-8.92)	(6.855)	(7.766)	(6.953)	(3.647)	(3.701)	(1.465)	(0.71)	(-1.41)
(-6%,-4%]* NETSELL	-0.253*	-0.231**	0.008	0.116	0.028	-0.295	-0.04	0.387	0
	(-1.877)	(-2.442)	(0.082)	(1.522)	(0.343)	(-0.925)	(-0.131)	(1.511)	(-0.001)
SIZE	0.001***	0.001***	0***	0	0**	0.002***	-0.002***	-0.001**	-0.002***
	(5.655)	(5.504)	(2.969)	(0.243)	(-2.295)	(3.664)	(-5.308)	(-2.347)	(-6.813)
TURNOVER	-0.005	-0.02***	-0.05***	-0.044***	-0.009**	0.044***	-0.064***	-0.012	0.027*
	(-0.673)	(-4.871)	(-11.251)	(-10.603)	(-2.424)	(2.584)	(-4.007)	(-0.803)	(1.905)
VARIANCE	0	0***	0**	0	0	0.001	0	0.001	0
	(1.611)	(-3.547)	(-2.246)	(-0.498)	(-0.129)	(1.434)	(1.483)	(1.576)	(-1.016)
BETA	0.017***	-0.003***	0.004***	0.002***	0.001	0.002	0.003	0	-0.003**
	(19.494)	(-6.511)	(8.629)	(4.103)	(1.352)	(0.693)	(1.548)	(-0.109)	(-2.239)
constant	-0.035***	-0.008***	-0.011***	-0.003	0.003	-0.033***	0.054***	0.03***	0.067***
	(-8.728)	(-3.588)	(-4.866)	(-1.624)	(1.488)	(-3.117)	(5.929)	(3.487)	(8.451)
Number	75678	75672	75663	75661	75653	75634	75589	75342	73219
R.2	0.074	0.005	0.006	0.006	0.002	0.003	0.005	0	0.003
Adjust.R.2	0.074	0.005	0.006	0.006	0.002	0.003	0.004	0	0.002

5.3 Robustness check

Similar to Dennis and Strickland (2002), we also define the extreme days as the absolute market return exceeding three standard deviations above mean. As such, we have 13 up and 24 down extreme days in SHSE, and 4 up and 25 down extreme days in SZSE. Our robustness checks do not include Shenzhen up days due to the lack of extreme day samples. Overall, the results of robustness check are quantitatively and qualitatively similar.

6. Conclusion

Utilizing the company level data of all listed stocks in Shanghai and Shenzhen Stock Exchanges from 2010 to 2017, we investigate the impact of large trading, mostly initiated by institutional investors, on firm performance during extreme movement days. The post extreme day returns for price limit hitting stocks have been further examined, through which we find large trading on extreme day has significantly predictive power regarding to post extreme day returns. Price limit plays an important role for delayed price discovery on extreme days, and the trading behaviour by large investors not only

exacerbates the volatile market, but also impacts on the returns on post extreme days, particularly for the price limit hitting samples.

In our extreme day study, we obtain the daily cash flow data for the largest trading group, as mostly traded by institutional investors. Our descriptive statistics suggest that on average, the large traders perform net buy (sell) behaviour on extreme up (down) days in Shanghai and Shenzhen stock Exchanges. We then investigate the impact of large trading, as a proxy for institutional trading, on firm performance on extreme days. We find significantly strong evidence that the trading initiated by large investors exacerbates the volatile stock market, which contrasts with Tian *et al.* (2018), suggesting that institutional ownership data used in prior extreme day study do not provide the clear institutional daily trading pattern. In the down extreme days, however, the net sell by large investors tend to decrease the abnormal turnover.

In post extreme day study, we find the post extreme day stock return consistently continues to increase (decrease) for at least two subsequent days for regular stocks hitting 10% (-10%) price limit, which is contrast to Chen *et al.* (2019) who claim a significantly moderate price reversal on first subsequent day, indicating a delayed price discovery effect from the price limit policy. Our results provide strong evidence that net buying (selling) has significantly predictive power for price limit hitting stocks' return (particularly for regular stocks) in subsequent days in both markets.

Reference

Barclay, M.J., Holderness, C.G., 1989. Private benefits from control of public corporations, *Journal of Financial Economics*, 25 (2), 371-395.

Banz, R., 1981. The relationship between return and market value of common stocks. *Journal of Financial Economics*, 9(1), 3-18.

Boehmer, E., Kelley, E.K., 2009. Institutional investors and the informational efficiency of prices, *Review of Financial Studies*, 22(9), 3563–3594.

Campbell J. Y., Ramadorai T., Schwartz A., 2009. Caught on Tape: Institutional Trading, Stock Returns and Earnings Announcements, *Journal of Financial Economics*, 92 (1), 66-91.

Chen, G., Rui, O.M., Wang, S.S., 2005. The effectiveness of price limits and stock characteristics: evidence from the Shanghai and Shenzhen stock exchanges. *Review of Quantitative Finance and Accounting*, 25 (2), 159–182.

Chen, T., Gao, Z., He, J., Jiang, W., Xiong, W., 2019. Daily price limits and destructive market behavior, *Journal of Econometrics*, 208 (1), 249-264.

Dennis, P.J., Strickland, D., 2002. Who blinks in volatile markets, individuals or institutions? *Journal of Finance*, 57(5), 1923–1949.

Fama, E., French, K., 1993. Common risk factors in the returns on stocks and bonds. *Journal of Financial Economics*, 33(1), 3-56.

Falkenstein, E. G., 1996. Preferences for stock characteristics as revealed by mutual fund portfolio holdings. *Journal of Finance*, 51, 111-135

Gompers, P. A., Metrick, A., 2001. Institutional investors and equity prices. *Quarterly Journal of Economics*, 116, 229-259

Jiang, G.J., Yuksel, H.Z., 2017. What drives the "Smart-Money" effect? Evidence from investors' money flow to mutual fund classes, *Journal of Empirical Finance*, 40, 39-58.

Jotikasthira, C., Lundblad, C., Ramadorai, T., 2012. Asset fire sales and purchases and the international transmission of funding shocks. *Journal of Finance*, 67 (6), 2015-2050.

Li, H., Zheng, D., Chen, J., 2014. Effectiveness, cause and impact of price limit—Evidence from China's cross-listed stocks. *Journal of International Financial Markets, Institutions and Money*, 29, 217-241.

Lipson, M., Puckett, A., 2010. Institutional trading during extreme market movements. Working paper Darden Graduate School of Business Administration, the University of Virginia.

Hotchkiss, E.S., Strickland, D., 2003. Does Shareholder Composition Matter? Evidence from the Market Reaction to Corporate Earnings Announcements, *Journal of Finance*, 58 (4), 1469-1498.

Lakonishok, J., Shleifer, A., Vishny, R.W., 1992. The impact of institutional trading on stock prices. *Journal of Financial Economics*, 32(1), 23-43.

Li, H., Zheng, D., Chen, J., 2014. Effectiveness, cause and impact of price limit—Evidence from China's cross-listed stocks, *Journal of International Financial Markets, Institutions and Money*, 29, 217-241.

Kim, K.A., Rhee, S.G., 1997. Price Limit Performance: Evidence from the Tokyo Stock Exchange. *Journal of Finance*, 52 (2), 885-901.

Kirchler, M., Bonn, C., Huber, J., Razen, M., 2015. The "inflow-effect"—Trader inflow and price efficiency, *European Economic Review*, 77, 1-19.

Nofsinger, J. R., Sias, R. W., 1999. Herding and feedback trading by institutional and individual investors. *Journal of Finance*, 54 (6), 2263–2295.

Porta, R.L., Lopez-de-Silanes, F., 2002. Corporate Ownership Around the World. *Journal of Finance*. 54 (2). Pages 471-517

Sun, Q., Tong, W.H.S., 2003, China share issue privatization: the extent of its success, *Journal of Financial Economics*, 70 (2), 183-222.

Sias, R.W., 2004. Institutional herding. *Review of Financial Studies*, 17(1), 165–206.

Ma, S., Naughton, T., Tian, G., 2010. Ownership and ownership concentration: which is important in determining the performance of China's listed firms? *Accounting and Finance*, 50 (4), 871-897.

Razen, M., Huber, J., Kirchler, M, 2017. Cash inflow and trading horizon in asset markets, *European Economic Review*, 92, 359-384.

Tian, S., Wu, E., Wu, Q., 2018. Who exacerbates the extreme swings in the Chinese stock market? *International Review of Financial Analysis*, 55, 50-59.

Wermers, R., 1999. Mutual fund herding and the impact on stock prices. *Journal of Finance*, 54 (2), 581–622.

Wermers, R., 2000. Mutual fund performance: An empirical decomposition into stock picking talent, style, transactions costs, and expense. *Journal of Finance*, 55, 1655-1695.

Wong, W.K., Liu, B., Zeng, Y., 2009. Can price limits help when the price is falling? Evidence from transactions data on the Shanghai Stock Exchange, *China Economic Review*, 20 (1), 91-102.

Yang, C., Yang, J., 2019. Individual Stock Cash Inflow–Outflow Imbalance, Individual Stock Investor Sentiment and Excess Returns. *Emerging Markets Finance and Trade*.

Appendix A. Extreme days in Shanghai and Shenzhen Stock Exchange

Appendix A. reports all extreme days in Shanghai (Shenzhen) stock market when the absolute market value exceeds two standard deviations above mean. The table illustrates the extreme date, market return, number of A-shares, number of regular shares, number of regular shares for upper price limit hitting, number of ST shares, number of ST shares for upper price limit hitting and the percentage of upper price limit hitting for all A-shares.

Panel A: Shanghai Up Extreme days

Date	Mean Return (%)	Number	Regular	Upper Hit (Regular)	ST	Upper Hit (ST)	Total Upper Hit
24/05/2010	3.48	832	755	26	77	20	5.5%
21/06/2010	2.9	831	752	4	79	7	1.3%
08/10/2010	3.13	843	767	18	76	6	2.8%
15/10/2010	3.18	835	760	14	75	3	2%
13/12/2010	2.88	844	770	12	74	4	1.9%
25/08/2011	2.92	877	801	8	76	2	1.1%
12/10/2011	3.04	887	808	11	79	4	1.7%
09/01/2012	2.89	891	818	24	73	19	4.8%
17/01/2012	4.18	887	815	53	72	19	8.1%
07/09/2012	3.7	924	885	31	39	1	3.5%
05/12/2012	2.87	921	880	17	41	5	2.4%
14/12/2012	4.32	919	879	23	40	3	2.8%
14/01/2013	3.06	920	881	23	39	4	2.9%
11/07/2013	3.23	907	879	16	28	1	1.9%
09/09/2013	3.39	917	891	23	26	0	2.5%
18/11/2013	2.87	905	877	17	28	1	2%
02/12/2014	3.11	890	870	27	20	1	3.1%
04/12/2014	4.31	889	869	34	20	1	3.9%
08/12/2014	2.81	897	877	52	20	1	5.9%
10/12/2014	2.93	906	885	46	21	2	5.3%
25/12/2014	3.36	908	886	26	22	4	3.3%
05/01/2015	3.58	915	891	51	24	1	5.7%
15/01/2015	3.54	917	893	11	24	0	1.2%
21/01/2015	4.74	919	895	25	24	2	2.9%
27/04/2015	3.04	941	919	52	22	4	6%
11/05/2015	3.04	938	913	79	25	8	9.3%
19/05/2015	3.13	940	918	57	22	9	7%
22/05/2015	2.83	938	917	107	21	11	12.6%
25/05/2015	3.35	934	913	122	21	10	14.1%
01/06/2015	4.71	933	912	159	21	8	17.9%
30/06/2015	5.53	947	925	103	22	0	10.9%
09/07/2015	5.76	661	640	576	21	4	87.7%
10/07/2015	4.54	694	673	587	21	14	86.6%

17/07/2015	3.51	926	905	151	21	8	17.2%
29/07/2015	3.44	941	919	156	22	2	16.8%
04/08/2015	3.69	932	911	204	21	7	22.6%
10/08/2015	4.92	934	911	119	23	7	13.5%
27/08/2015	5.34	907	886	110	21	0	12.1%
28/08/2015	4.82	909	888	218	21	13	25.4%
08/09/2015	2.92	912	890	104	22	7	12.2%
16/09/2015	4.89	920	898	334	22	8	37.2%
08/10/2015	2.97	917	894	47	23	2	5.3%
12/10/2015	3.28	917	894	43	23	3	5%
04/11/2015	4.31	922	900	54	22	3	6.2%
19/01/2016	3.22	998	972	54	26	15	6.9%
29/01/2016	3.09	1006	979	26	27	3	2.9%
16/02/2016	3.29	1003	976	50	27	6	5.6%
02/03/2016	4.26	990	964	72	26	11	8.4%
31/05/2016	3.34	1013	990	24	23	1	2.5%

Panel B: Shanghai Down Extreme days

Date	Mean Return (%)	Number	Regular	Lower Hit (Regular)	ST	Lower Hit (ST)	Total Lower Hit
13/01/2010	-3.09	839	769	0	70	3	0.4%
20/01/2010	-2.93	834	767	0	67	12	1.4%
19/04/2010	-4.79	823	752	18	71	40	7%
06/05/2010	-4.11	840	761	7	79	13	2.4%
17/05/2010	-5.07	834	758	97	76	49	17.5%
29/06/2010	-4.27	817	746	28	71	43	8.7%
10/08/2010	-2.89	834	759	1	75	9	1.2%
12/11/2010	-5.16	831	755	66	76	54	14.4%
16/11/2010	-3.98	842	766	15	76	13	3.3%
17/01/2011	-3.03	858	779	7	79	15	2.6%
20/01/2011	-2.92	849	771	2	78	8	1.2%
23/05/2011	-2.93	859	784	6	75	38	5.1%
25/07/2011	-2.96	877	802	5	75	25	3.4%
08/08/2011	-3.79	866	792	20	74	43	7.3%
30/11/2011	-3.27	882	809	4	73	19	2.6%
21/02/2013	-2.97	918	887	0	31	1	0.1%
04/03/2013	-3.65	912	882	37	30	3	4.4%
28/03/2013	-2.82	914	887	3	27	1	0.4%
13/06/2013	-2.83	898	870	5	28	7	1.3%
24/06/2013	-5.3	901	872	69	29	14	9.2%
10/03/2014	-2.86	915	894	6	21	0	0.7%
09/12/2014	-5.43	902	881	61	21	13	8.2%
23/12/2014	-3.03	906	883	12	23	3	1.7%
19/01/2015	-7.7	920	896	99	24	5	11.3%
05/05/2015	-4.06	935	909	12	26	10	2.4%
28/05/2015	-6.5	934	912	225	22	11	25.3%
16/06/2015	-3.47	929	909	27	20	15	4.5%
18/06/2015	-3.67	932	911	33	21	11	4.7%
19/06/2015	-6.42	934	913	381	21	18	42.7%
25/06/2015	-3.46	947	925	28	22	5	3.5%
26/06/2015	-7.4	951	929	736	22	21	79.6%
29/06/2015	-3.34	947	925	471	22	19	51.7%
01/07/2015	-5.23	946	924	318	22	19	35.6%
02/07/2015	-3.48	942	920	526	22	20	58%
03/07/2015	-5.77	933	911	536	22	22	59.8%

08/07/2015	-5.9	710	690	494	20	18	72.1%
15/07/2015	-3.03	928	906	563	22	21	62.9%
27/07/2015	-8.48	939	918	720	21	17	78.5%
18/08/2015	-6.15	928	905	621	23	18	68.9%
20/08/2015	-3.42	930	907	61	23	5	7.1%
21/08/2015	-4.27	931	908	90	23	16	11.4%
24/08/2015	-8.49	924	903	787	21	21	87.4%
25/08/2015	-7.63	918	897	708	21	19	79.2%
15/09/2015	-3.52	921	898	227	23	17	26.5%
21/10/2015	-3.06	899	876	284	23	17	33.5%
27/11/2015	-5.48	950	927	91	23	14	11.1%
04/01/2016	-6.86	983	960	382	23	21	41%
07/01/2016	-7.04	989	964	422	25	22	44.9%
11/01/2016	-5.33	987	962	378	25	24	40.7%
15/01/2016	-3.55	994	968	29	26	3	3.2%
21/01/2016	-3.23	1002	976	35	26	8	4.3%
26/01/2016	-6.42	1001	975	270	26	19	28.9%
28/01/2016	-2.92	1005	979	67	26	9	7.6%
25/02/2016	-6.41	990	964	436	26	21	46.2%
29/02/2016	-2.86	987	961	139	26	21	16.2%
06/05/2016	-2.82	1004	979	9	25	13	2.2%
13/06/2016	-3.21	1019	993	41	26	14	5.4%

Panel C: Shenzhen Up Extreme days

Date	Mean Return (%)	Number	Regular	Upper Hit (Regular)	ST	Upper Hit (ST)	Total Upper Hit
24/05/2010	4.28	906	855	33	51	19	5.7%
12/10/2011	3.5	1299	1253	21	46	4	1.9%
09/01/2012	3.72	1336	1295	27	41	14	3.1%
10/01/2012	3.85	1345	1304	40	41	9	3.6%
17/01/2012	5.14	1342	1300	46	42	14	4.5%
07/09/2012	3.75	1471	1427	34	44	2	2.4%
05/12/2012	3.78	1478	1441	26	37	2	1.9%
14/12/2012	4.12	1481	1441	20	40	3	1.6%
14/01/2013	3.63	1471	1431	37	40	2	2.7%
10/12/2014	3.5	1412	1399	68	13	2	5%
20/01/2015	3.39	1402	1389	69	13	3	5.1%
21/04/2015	3.88	1392	1381	112	11	8	8.6%
08/05/2015	4.17	1414	1400	198	14	2	14.1%
11/05/2015	4.48	1421	1407	203	14	4	14.6%
21/05/2015	3.59	1419	1404	276	15	5	19.8%
26/05/2015	3.58	1399	1384	248	15	8	18.3%
01/06/2015	4.79	1385	1371	286	14	4	20.9%
02/06/2015	3.52	1381	1366	297	15	4	21.8%
30/06/2015	4.8	1388	1375	180	13	1	13%
09/07/2015	3.76	678	667	645	11	7	96.2%
10/07/2015	4.09	701	690	660	11	7	95.1%
13/07/2015	4.18	842	831	753	11	7	90.3%
17/07/2015	4.98	1223	1210	356	13	2	29.3%
29/07/2015	4.13	1322	1308	245	14	3	18.8%
04/08/2015	4.77	1333	1319	439	14	6	33.4%
10/08/2015	4.49	1333	1320	183	13	7	14.3%
28/08/2015	5.4	1366	1353	347	13	5	25.8%
08/09/2015	3.83	1386	1372	232	14	1	16.8%
16/09/2015	6.52	1405	1391	728	14	4	52.1%

21/09/2015	3.55	1411	1396	170	15	3	12.3%
08/10/2015	4	1427	1411	138	16	1	9.7%
12/10/2015	4.18	1433	1416	138	17	7	10.1%
22/10/2015	3.71	1435	1420	169	15	2	11.9%
04/11/2015	5.12	1471	1453	144	18	2	9.9%
14/01/2016	3.81	1561	1541	108	20	2	7%
19/01/2016	3.57	1556	1536	91	20	13	6.7%
29/01/2016	3.71	1549	1529	77	20	3	5.2%
02/02/2016	3.42	1550	1530	91	20	7	6.3%
16/02/2016	4.1	1557	1538	124	19	7	8.4%
02/03/2016	4.7	1553	1536	118	17	8	8.1%
14/03/2016	3.56	1553	1537	80	16	5	5.5%
17/03/2016	3.56	1555	1538	76	17	1	5%
18/03/2016	3.65	1553	1536	103	17	1	6.7%
30/03/2016	3.6	1536	1522	82	14	0	5.3%
31/05/2016	4.09	1540	1523	72	17	2	4.8%

Panel D: Shenzhen Down Extreme days

Date	Mean Return (%)	Number	Regular	Lower Hit (Regular)	ST	Lower Hit (ST)	Total Lower Hit
20/01/2010	-3.67	814	768	8	46	6	1.7%
19/04/2010	-4.42	879	828	17	51	22	4.4%
06/05/2010	-3.65	891	837	6	54	10	1.8%
17/05/2010	-5.97	888	838	105	50	30	15.2%
18/06/2010	-3.61	929	876	26	53	12	4.1%
29/06/2010	-5.44	934	885	42	49	30	7.7%
12/11/2010	-6.12	1048	1001	78	47	32	10.5%
16/11/2010	-3.49	1051	1002	16	49	9	2.4%
17/01/2011	-4.25	1111	1062	23	49	11	3.1%
20/01/2011	-3.4	1119	1072	1	47	4	0.4%
23/05/2011	-3.63	1192	1143	14	49	30	3.7%
25/07/2011	-3.75	1249	1204	6	45	13	1.5%
08/08/2011	-4.43	1259	1215	46	44	28	5.9%
30/11/2011	-4.01	1315	1275	23	40	19	3.2%
05/01/2012	-3.52	1329	1288	73	41	16	6.7%
13/01/2012	-3.52	1331	1290	34	41	4	2.9%
14/03/2012	-4.09	1370	1332	3	38	21	1.8%
28/03/2012	-4.06	1370	1328	31	42	23	3.9%
16/07/2012	-3.63	1448	1402	83	46	9	6.4%
04/03/2013	-3.54	1482	1430	32	52	13	3%
20/06/2013	-3.39	1461	1436	4	25	3	0.5%
24/06/2013	-6.1	1460	1435	96	25	15	7.6%
08/07/2013	-3.57	1455	1434	18	21	6	1.6%
02/12/2013	-4.96	1431	1409	334	22	14	24.3%
25/02/2014	-3.96	1466	1446	69	20	3	4.9%
10/03/2014	-3.47	1464	1446	37	18	1	2.6%
09/12/2014	-4.31	1410	1397	122	13	6	9.1%
22/12/2014	-3.64	1414	1400	200	14	6	14.6%
19/01/2015	-3.39	1403	1391	36	12	1	2.6%
15/04/2015	-3.68	1383	1372	85	11	3	6.4%
28/05/2015	-5.52	1401	1386	321	15	7	23.4%
16/06/2015	-3.59	1395	1384	101	11	9	7.9%
18/06/2015	-3.57	1390	1377	109	13	5	8.2%
19/06/2015	-5.88	1393	1380	593	13	13	43.5%
25/06/2015	-3.76	1400	1387	106	13	3	7.8%

26/06/2015	-7.87	1409	1396	1232	13	11	88.2%
29/06/2015	-6.05	1401	1388	1024	13	12	73.9%
01/07/2015	-4.79	1396	1383	540	13	11	39.5%
02/07/2015	-5.55	1378	1365	900	13	12	66.2%
03/07/2015	-5.3	1336	1323	818	13	11	62.1%
07/07/2015	-5.34	1135	1122	982	13	12	87.6%
15/07/2015	-4.22	1167	1154	637	13	12	55.6%
27/07/2015	-7	1312	1299	1021	13	11	78.7%
18/08/2015	-6.58	1364	1351	915	13	11	67.9%
21/08/2015	-5.39	1373	1360	248	13	11	18.9%
24/08/2015	-7.7	1376	1363	1304	13	11	95.6%
25/08/2015	-7.09	1379	1366	1166	13	10	85.3%
01/09/2015	-4.61	1377	1363	718	14	9	52.8%
14/09/2015	-6.65	1395	1381	968	14	10	70.1%
15/09/2015	-4.97	1399	1385	466	14	11	34.1%
25/09/2015	-3.44	1414	1398	49	16	2	3.6%
21/10/2015	-5.94	1427	1414	549	13	12	39.3%
27/11/2015	-6.09	1511	1493	210	18	5	14.2%
04/01/2016	-8.22	1563	1545	906	18	16	59%
07/01/2016	-8.24	1564	1546	939	18	16	61.1%
11/01/2016	-6.6	1556	1537	865	19	16	56.6%
13/01/2016	-3.46	1563	1543	129	20	11	9%
15/01/2016	-3.4	1565	1545	53	20	1	3.5%
21/01/2016	-4.01	1556	1536	78	20	6	5.4%
26/01/2016	-7.12	1559	1540	734	19	13	47.9%
28/01/2016	-4.18	1555	1535	180	20	10	12.2%
25/02/2016	-7.34	1549	1533	907	16	12	59.3%
29/02/2016	-5.37	1548	1533	449	15	10	29.7%
20/04/2016	-4.43	1518	1501	58	17	7	4.3%
06/05/2016	-3.65	1541	1519	16	22	8	1.6%
09/05/2016	-3.59	1536	1514	84	22	14	6.4%
13/06/2016	-4.76	1545	1528	189	17	10	12.9%
27/07/2016	-4.45	1605	1583	72	22	7	4.9%
12/12/2016	-4.86	1701	1673	169	28	10	10.5%
16/01/2017	-3.62	1737	1706	57	31	17	4.3%
17/07/2017	-4.28	1810	1792	361	18	9	20.4%

Appendix B. Analysis of ST stocks

Appendix B. firstly demonstrates the methodology of regression for ST stocks and then report the tables of post extreme day findings for ST stocks.

The regression of ST samples in extreme up days is specified as follows:

$$RET_{i,t+n\to t+m} = \gamma_0 + \gamma_1 UFIVE_{i,t} + \gamma_2 NETBUY_{i,t} + \gamma_3 UFIVE_{i,t} * NETBUY_{i,t} + \gamma_{10} SIZE_{i,t} + \gamma_{11} TURNOVER_{i,t} + \gamma_{12} VARIANCE_{i,t} + \gamma_{13} BETA_{i,t} + \varepsilon_{i,t}, n, m \in \{1,2,3,4,5,10,20,60,120\} \text{ (B-7)}$$

where, $RET_{i,t+n\to t+m}$ is the dependent variable, referring to the market-adjusted abnormal returns on day 1,2,3,4,5 and cumulative abnormal returns over days [6, 10], [11, 20], [21, 60] and [61, 120] for stock i after up extreme day t. $UFIVE_{i,t}$ is dummy variable and equals to one if the ST stock i on event t hits the upper price limit of 5%. All other variables are defined as earlier.

The coefficient on the interaction term between *UFIVE* and *NETBUY* is our core interest in the study. The positive coefficient of γ_3 translates Hypothesis 3, indicating the stronger price delayed effect after upper-price-limit hits with greater net buy of large trading investors in up extreme days.

The regression of ST samples in extreme down days is specified as follows:

$$RET_{i,t+n\to t+m} = \gamma_0 + \gamma_1 LFIVE_{i,t} + \gamma_2 NETBUY_{i,t} + \gamma_3 LFIVE_{i,t} * NETBUY_{i,t} + \gamma_{10} SIZE_{i,t} + \gamma_{11} TURNOVER_{i,t} + \gamma_{12} VARIANCE_{i,t} + \gamma_{13} BETA_{i,t} + \varepsilon_{i,t}, n, m \in \{1,2,3,4,5,10,20,60,120\} \text{ (B-8)}$$

where, $RET_{i,t+n\to t+m}$ is the dependent variable, referring to the market-adjusted abnormal returns on day 1,2,3,4,5 and cumulative abnormal returns over days [6, 10], [11, 20], [21, 60] and [61, 120] for stock i after up extreme day t. $UFIVE_{i,t}$ is dummy variable and equals to one if the ST stock i on event t hits the lower price limit of 5%. All other variables are defined as earlier.

The coefficient on the interaction term between *LFIVE* and *NETSELL* is our core interest in the study. The positive coefficient of γ_3 translates Hypothesis 3, indicating the stronger price delayed effect after lower-price-limit hits with greater net buy of large trading investors in down extreme days.

Table B-1 Post extreme day performance of ST stocks in Shanghai stock market

Table B-1 presents the abnormal returns of ST stocks subsequent to extreme days in Shanghai stock market. The sample includes all ST stocks listed in Shanghai stock market from 2010 to 2017. CTO refers to the return calculated from the close price in extreme day and the open price in the following day. OTC refers to the return calculated from the open and close price on the following day. Day 2, 3, 4 and 5 refer to the abnormal return on the 2nd, 3rd, 4th and 5th relative to extreme day. [6, 10], [11, 20], [21, 60] and [61, 120] refer to the cumulative abnormal return from time window over 6th to 10th, 11th, to 20th, 21st to 60th, and 61st to 120th day relative to extreme day. The abnormal return is calculated as using stock's daily return minus the expected return derived from market model. The table reports log returns. "***", "**" and "*" represent the significance level at 0.1%, 1% and 5% respectively.

	CTO	OTC	Day 2	Day 3	Day 4	Day 5	[6, 10]	[11, 20]	[21, 60]	[61, 120]	No.
Panel A ST stocks in Shanghai up extreme days											
Upper Hit	0.84%	0.38%*	0.54%**	0.3%	0.02%	0.04%	0.58%	-0.95%	0.8%	0.41%	213
[4%, 5%)	0.03%	0.73%***	0.34%	0.5%*	0.49%*	0.11%	0.39%	1.22%*	0.35%	-0.56%	148
[3%, 4%)	0.04%	0.88%***	0.33%*	0.38%*	-0.08%	0.31%	1.38%**	0.7%	1.34%**	0.54%	176
[2%, 3%)	-0.17%**	0.71%***	0.42%**	0.62%***	-0.14%	0%	1.34%*	0.62%	0.56%	1.22%*	240
[-2%, 2%)	-0.11%*	0.09%	0.12%	0.07%	-0.58%***	0.07%	-0.36%	-0.51%	0.6%	0.05%	477
(-5%, -2%)	0.14%	-1.14%*	-0.46%	-1.02%*	-1.51%**	-0.72%	-1.41%	-1.28%	-0.12%	-2.23%	45
Lower Hit	-2.28%***	-0.34%	-2.38%***	-2.06%***	-2.46%***	-0.44%	-1.17%	0.43%	-0.09%	0.56%	31
Panel B ST stocks in Shanghai down extreme days											
Upper Hit	1.68%*	0.1%	0.3%	-0.08%	-1.79%	-0.78%	-0.94%	-0.24%	0.6%	3.1%	26
[2%, 5%)	-0.18%	0.24%	-0.61%	-0.37%	-1.07%*	-0.75%	0.59%	0.8%	-1.01%	0.33%	50
[-2%, 2%)	-0.54%***	0.92%***	-0.07%	0.04%	-0.67%***	-0.38%*	0.79%*	0.39%	0.98%*	0.5%	265
[-3%, -2%)	-0.18%	0.55%**	0.08%	-0.18%	-0.45%*	-0.7%***	0.03%	0.4%	-0.06%	0.94%	159
[-4%, -3%)	-0.51%***	1.03%***	-0.08%	-0.13%	-0.25%	-0.24%	0.91%*	1.31%**	0.94%*	0.29%	179
(-5%, -4%)	-1.06%***	0.37%**	-0.18%	-0.48%***	-0.51%***	-0.19%	-0.42%	0.22%	1%*	1.45%**	305
Lower Hit	-2.46%***	0.1%	-0.86%***	-0.81%***	-0.89%***	-0.52%***	-1.17%***	0.24%	-0.06%	0.35%	796

Table B-2 Post extreme day performance of ST stocks in Shenzhen stock market

Table B-1 presents the abnormal returns of ST stocks subsequent to extreme days in Shenzhen stock market. The sample includes all ST stocks listed in Shenzhen stock market from 2010 to 2017. CTO refers to the return calculated from the close price in extreme day and the open price in the following day. OTC refers to the return calculated from the open and close price on the following day. Day 2, 3, 4 and 5 refer to the abnormal return on the 2nd, 3rd, 4th and 5th relative to extreme day. [6, 10], [11, 20], [21, 60] and [61, 120] refer to the cumulative abnormal return from time window over 6th to 10th, 11th, to 20th, 21st to 60th, and 61st to 120th day relative to extreme day. The abnormal return is calculated as using stock's daily return minus the expected return derived from market model. The table reports log returns. "***", "**" and "*" represent the significance level at 0.1%, 1% and 5% respectively.

	CTO	OTC	Day 2	Day 3	Day 4	Day 5	[6, 10]	[11, 20]	[21, 60]	[61, 120]	No.
Panel A ST stocks in Shenzhen up extreme days											
Upper Hit	1.24%***	0.26%	0.81%***	0.47%*	0.44%	0.59%*	1.08%	0.23%	0.01%	1.62%	148
[4%, 5%)	-0.19%	0.95%***	0.24%	0.28%	0.18%	0.36%	0.69%	1.68%	1.21%	-0.13%	97
[3%, 4%)	-0.24%*	0.63%**	0.17%	0.43%*	0.42%	0.23%	0.77%	1.78%**	1.45%*	0.76%	96
[2%, 3%)	-0.12%	0.62%***	0.29%	0.38%*	0.1%	0.26%	0.57%	0.8%	1.39%*	0.52%	138
[-2%, 2%)	-0.12%	0.58%**	0.54%*	0.03%	0.59%**	0.49%*	1.06%	-1.11%	2.25%**	0.55%	142
(-5%,-2%)	-1.06%	-3.45%**	0.71%	1.3%	-0.05%	0.11%	-5.12%	-5.86%	-0.06%	0.21%	8
Lower Hit	-3.25%*	1.51%	-2.76%	-0.74%	-0.33%	-0.97%	1.76%	0.49%	7.39%	9.39%	8
Panel B ST stocks in Shenzhen down extreme days											
Upper Hit	-0.38%	0.67%	-1.03%	-1.73%	-0.24%	-0.03%	-1.18%	-0.01%	1.79%	-2.2%	17
[4%, 5%)	-1.11%***	0.82%	-1.35%**	-0.85%	-0.91%*	-0.88%*	-3.42%**	-1.43%	0.03%	-0.35%	39
[3%, 4%)	-0.67%***	0.6%**	-0.17%	-0.4%*	-0.34%*	-0.47%**	-0.44%	-0.22%	0.23%	0.93%	170
[2%, 3%)	-0.49%***	0.8%**	0.36%*	-0.09%	-0.12%	-0.12%	-0.08%	0.92%	0.32%	0.95%	105
[-2%, 2%)	-0.54%***	0.62%**	0.37%*	0.02%	-0.11%	-0.25%	-0.03%	0.14%	-0.16%	0.49%	139
(-5%,-2%)	-0.86%***	0.21%	0.08%	0.02%	0.04%	0.04%	0.2%	0.52%	1.22%**	0.77%	254
Lower Hit	-2.23%***	0.07%	-0.52%***	-0.29%**	-0.26%*	-0.02%	-0.09%	-0.06%	0.59%	0.99%**	564

Table B-3 Regression analysis for ST stocks in Shanghai Stock Exchange

This table reports the regression evidence of ST stocks estimated from Eq. (B-7) and (B-8) in extreme days in Shanghai stock market over 2010 to 2017, while samples are further separated according to from up or down extreme day. Panel A reports the regressions for ST stocks in extreme up days, in which the key variable UFIVE refers to regular stocks hitting 5% price limit and NETBUY refers to net buy of large trading investors. Panel B reports the regressions for ST stocks in extreme down days, in which the key variable LFIVE refers to regular stocks hitting -5% price limit and NETSELL refers to net buy of large trading investors. All other variables are same as defined earlier. Standard errors are adjusted for heteroscedasticity and t-statistics are reported in parentheses.

Panel A ST stocks from Shanghai up extreme days									
	AR Day1	AR Day2	AR Day3	AR Day4	AR Day5	CAR [6,10]	CAR [11,20]	CAR [21,60]	CAR [61,120]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
UFIVE	0.007	0.005***	0.002	0.006***	0.001	-0.004	-0.006	0.006	0.008
	(1.399)	(2.958)	(0.893)	(2.851)	(0.262)	(-0.95)	(-0.899)	(0.779)	(0.814)
NETBUY	0.607***	0.206	-0.055	-0.336**	-0.676***	0.027	0.164	0.902**	-0.079
	(3.492)	(1.459)	(-0.335)	(-2.419)	(-6.209)	(0.048)	(0.377)	(2.165)	(-0.2)
UFIVE* NETBUY	0.267	-0.201	0.075	-0.103	0.344	0.976*	-0.682	-0.77	-0.636
	(0.675)	(-1.319)	(0.336)	(-0.525)	(1.079)	(1.817)	(-1.01)	(-1.213)	(-0.831)
SIZE	0	-0.003***	0.001	0	0.003***	0.003	-0.007***	-0.005	-0.006**
	(0.169)	(-2.963)	(0.56)	(0.45)	(3.12)	(0.868)	(-2.662)	(-1.441)	(-1.961)
TURNOVER	-0.15***	-0.14***	-0.211***	-0.136***	-0.044	0.161	0.055	-0.019	-0.255**
	(-2.959)	(-2.757)	(-3.996)	(-2.914)	(-0.929)	(1.194)	(0.492)	(-0.143)	(-2.032)
VARIANCE	-0.043	-0.002	0.02	0.022	-0.015	0.063	0.071	-0.015	-0.009
	(-1.561)	(-0.118)	(0.794)	(1.386)	(-0.733)	(0.812)	(1.321)	(-0.29)	(-0.159)
BETA	-0.003	-0.002	-0.002	-0.003	-0.004	0.007	0.025***	0.029***	-0.004
	(-0.56)	(-0.559)	(-1.076)	(-1.106)	(-1.562)	(0.753)	(2.701)	(3.693)	(-0.451)
constant	0.005	0.068***	-0.005	-0.01	-0.055***	-0.077	0.122**	0.086	0.137**
	(0.211)	(3.213)	(-0.236)	(-0.453)	(-2.823)	(-1.003)	(2.161)	(1.204)	(2.187)
Number	1330	1330	1330	1330	1329	1328	1326	1313	1286
R.2	0.021	0.021	0.031	0.03	0.033	0.009	0.014	0.017	0.009
Adjust.R.2	0.016	0.016	0.026	0.025	0.027	0.004	0.008	0.012	0.004
Panel B ST stocks from Shanghai down extreme days									
	AR Day1	AR Day2	AR Day3	AR Day4	AR Day5	CAR [6,10]	CAR [11,20]	CAR [21,60]	CAR [61,120]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LFIVE	-0.023***	-0.006***	-0.005***	-0.002*	0	-0.01**	-0.003	-0.008**	-0.005
	(-16.771)	(-5.071)	(-4.673)	(-1.667)	(-0.173)	(-2.531)	(-0.852)	(-2.288)	(-1.456)
NETSELL	-0.331	0.299**	0.36***	-0.267	-0.347***	-0.02	0.561*	0.238	-0.028
	(-1.355)	(2.293)	(2.973)	(-1.374)	(-2.929)	(-0.07)	(1.707)	(0.695)	(-0.081)
LFIVE* NETSELL	0.701***	0.007	-0.181	0.013	0.137	0.003	-1.701***	-0.175	-0.055
	(2.666)	(0.035)	(-1.224)	(0.054)	(0.571)	(0.007)	(-3.569)	(-0.414)	(-0.12)
SIZE	-0.004***	-0.003***	-0.002***	-0.001*	-0.001	-0.008***	-0.001	-0.001	0.003
	(-3.919)	(-3.769)	(-2.655)	(-1.844)	(-0.645)	(-3.154)	(-0.449)	(-0.223)	(0.84)
TURNOVER	-0.125***	0.086**	0.031	-0.068*	-0.019	0.026	-0.149	-0.036	-0.046
	(-3.154)	(2.007)	(0.884)	(-1.913)	(-0.628)	(0.306)	(-1.578)	(-0.386)	(-0.334)
VARIANCE	-0.028	-0.003	-0.006	-0.017***	0.012**	0.013	0.002	0.039**	-0.033*
	(-1.505)	(-0.184)	(-0.751)	(-4.072)	(2.185)	(0.807)	(0.164)	(2.374)	(-1.79)
BETA	0.007*	0.008***	0.004*	0.006***	0.012***	0.027***	0.001	0.007	0.008
	(1.925)	(3.297)	(1.931)	(3.106)	(5.568)	(3.597)	(0.115)	(1.157)	(1.193)
constant	0.091***	0.052***	0.036**	0.016	-0.003	0.158***	0.025	0.012	-0.049
	(3.882)	(3.155)	(2.236)	(1.192)	(-0.17)	(2.756)	(0.648)	(0.228)	(-0.755)
Number	1780	1779	1779	1779	1779	1775	1767	1751	1725

R.2	0.142	0.04	0.021	0.014	0.019	0.025	0.007	0.005	0.003
Adjust.R.2	0.138	0.036	0.017	0.01	0.015	0.021	0.003	0.001	-0.001

Table B-4 Regression analysis for ST stocks in Shenzhen Stock Exchange

This table reports the regression evidence of ST stocks estimated from Eq. (B-7) and (B-8) in extreme days in Shenzhen stock market over 2010 to 2017, while samples are further separated according to from up or down extreme day. Panel A reports the regressions for ST stocks in extreme up days, in which the key variable UFIVE refers to regular stocks hitting 5% price limit and NETBUY refers to net buy of large trading investors. Panel B reports the regressions for ST stocks in extreme down days, in which the key variable LFIVE refers to regular stocks hitting -5% price limit and NETSELL refers to net buy of large trading investors. All other variables are same as defined earlier. Standard errors are adjusted for heteroscedasticity and t-statistics are reported in parentheses.

Panel A ST stocks from Shenzhen up extreme days									
	AR Day1	AR Day2	AR Day3	AR Day4	AR Day5	CAR [6,10]	CAR [11,20]	CAR [21,60]	CAR [61,120]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
UFIVE	0.012***	0.007***	0.005**	0.005**	0.005*	0.004	0.008	-0.011	0.019
	(3.769)	(2.576)	(2.283)	(2.099)	(1.75)	(0.568)	(1.135)	(-1.202)	(1.46)
NETBUY	0.03	-0.16	-0.13	0.208	-0.1	-0.093	1.418**	-1.196***	0.442
	(0.093)	(-0.519)	(-0.89)	(0.971)	(-0.271)	(-0.18)	(2.228)	(-3.683)	(0.94)
UFIVE* NETBUY	-0.269	-0.157	-0.619***	-0.904***	-0.363	0.77	-2.666**	-0.204	-2.62***
	(-0.348)	(-0.287)	(-2.904)	(-4.107)	(-0.544)	(1.105)	(-2.204)	(-0.438)	(-2.876)
SIZE	0.001	-0.005***	0	0.001	0	-0.005*	0	-0.014***	-0.004
	(0.502)	(-5.874)	(0.199)	(0.695)	(0.391)	(-1.731)	(0.016)	(-3.087)	(-0.87)
TURNOVER	0.013	-0.064	-0.11**	0.003	-0.022	-0.069	-0.226	0.359	0.124
	(0.099)	(-0.656)	(-2.304)	(0.035)	(-0.316)	(-0.339)	(-0.833)	(1.433)	(0.472)
VARIANCE	-0.034	0.05	0.042*	0.026	-0.021	-0.088	-0.219*	-0.029	0.125
	(-0.661)	(1.387)	(1.808)	(0.902)	(-0.641)	(-1.182)	(-1.692)	(-0.197)	(0.772)
BETA	0.002	-0.003	-0.009	-0.015**	-0.004	-0.028*	-0.016	0	-0.003
	(0.432)	(-0.495)	(-1.599)	(-2.495)	(-1.046)	(-1.865)	(-0.861)	(-0.005)	(-0.156)
constant	-0.01	0.111***	0.005	-0.004	0	0.142**	0.034	0.307***	0.089
	(-0.393)	(6.325)	(0.192)	(-0.146)	(0.004)	(2.252)	(0.34)	(3.245)	(0.872)
Number	637	637	637	637	637	637	636	627	609
R.2	0.026	0.039	0.047	0.032	0.013	0.014	0.032	0.032	0.013
Adjust.R.2	0.015	0.028	0.036	0.021	0.002	0.003	0.021	0.021	0.001
Panel B ST stocks from Shenzhen down extreme days									
	AR Day1	AR Day2	AR Day3	AR Day4	AR Day5	CAR [6,10]	CAR [11,20]	CAR [21,60]	CAR [61,120]
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
LFIVE	-0.019***	-0.006***	-0.002	-0.001	0.001	-0.001	-0.002	0	0.002
	(-9.966)	(-4.412)	(-1.179)	(-0.829)	(0.902)	(-0.182)	(-0.562)	(-0.101)	(0.514)
NETSELL	0.245	0.409***	-0.036	-0.438**	0.128	3.198***	0.214	0.418	0.445
	(0.828)	(3.605)	(-0.15)	(-2.561)	(1.033)	(2.789)	(0.605)	(1.007)	(1.162)
LFIVE* NETSELL	-0.962	0.347	0.84*	0.545	-0.13	-2.899*	0.61	-0.903	-0.516
	(-0.693)	(0.843)	(1.952)	(1.558)	(-0.388)	(-1.792)	(0.444)	(-1.045)	(-0.563)
SIZE	-0.003***	-0.002**	0	0.002*	0.003***	-0.003	-0.001	0.004	-0.002
	(-2.879)	(-2.536)	(0.095)	(1.882)	(3.344)	(-1.281)	(-0.26)	(1.621)	(-0.572)
TURNOVER	0.089	-0.11***	-0.053	-0.075*	-0.058*	0.087	-0.072	0.037	-0.17
	(1.186)	(-2.757)	(-1.559)	(-1.769)	(-1.69)	(0.685)	(-0.619)	(0.3)	(-1.346)
VARIANCE	-0.001	0.004	0.002	-0.002	0.003	0.016**	-0.005	-0.001	0.008
	(-0.69)	(1.443)	(1.386)	(-0.454)	(1.453)	(1.967)	(-1.494)	(-0.432)	(1.099)
BETA	-0.012***	-0.007**	0.004	0.002	0.002	-0.019**	-0.007	-0.005	0.006

	(-3.045)	(-2.334)	(1.396)	(0.51)	(0.518)	(-2.013)	(-0.97)	(-0.601)	(0.565)
Constant	0.068***	0.043***	-0.006	-0.035*	-0.058***	0.078	0.025	-0.083	0.043
	(3.177)	(3.06)	(-0.354)	(-1.95)	(-3.475)	(1.563)	(0.42)	(-1.383)	(0.667)
Number	1288	1288	1288	1287	1287	1286	1285	1276	1242
R.2	0.119	0.047	0.011	0.012	0.019	0.038	0.003	0.003	0.005
Adjust.R.2	0.114	0.042	0.005	0.006	0.013	0.033	-0.003	-0.003	0